Dissertação

Mestrado em Finanças Empresariais

Stock Market Liquidity Impact on Economic Development

Tiago Miguel Santos Silva

Leiria, setembro de 2018

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Dissertação de Mestrado realizada sob a orientação da Doutora Professora Lígia Febra, Professora da Escola Superior de Tecnologia e Gestão do Instituto Politécnico de Leiria e coorientação da Doutora Professora Eduarda Fernandes, Professora da Escola Superior de Tecnologia e Gestão do Instituto Politécnico de Leiria.

Leiria, setembro de 2018

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Agradecimentos

Gostaria de agradecer em especial ao meu pai, irmã e namorada por todo o apoio e compreensão demonstrados durante o período de elaboração desta dissertação.

Gostaria ainda de agradecer também à minha orientadora Prof. Lígia Febra e coorientadora Prof. Maria Eduarda Fernandes por todo apoio e ajuda que prestaram ao longo do desenvolvimento deste projeto, pois sem ele, não teria sido possível a conclusão desta dissertação.

Queria também agradecer a todos os meus amigos que de uma forma ou de outra contribuiram tanto para o desenvolvimento desta dissertação bem como para os necessários e importantes momentos de lazer e descontração.

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Resumo

Este trabalho analisa a relação entre a liquidez do mercado de capitais e o desenvolvimento económico dos países, que ultimamente tem sido alvo de interesse de vários investigadores por se considerar que a liquidez do mercado de capitais tem um impacto considerável no desenvolvimento económico de um país. No entanto, todos os estudos conhecidos utilizam apenas no crescimento económico como proxy para o desenvolvimento económico, em vez de se aplicar um índice composto por várias dimensões de forma a representar o verdadeiro desenvolvimento económico de um país.

Assim, o objetivo principal deste trabalho é contribuir para este ramo da literatura, utilizando o Índice de Desenvolvimento Humano como proxy para o desenvolvimento económico. A liquidez do mercado de capitais foi calculada com base na medida de iliquidez de Amihud (2002), que é atualmente uma das medidas mais fidedignas desta área.

O estudo foi realizado com base numa amostra ampla e diversificada, contando com 59 países. O período amostral compreende-se entre 1990 e 2015, sendo os dados de frequência anual. Primeiro foi testada a correlação entre a liquidez e o desenvolvimento económico de cada país utilizando o teste não-paramétrico de correlação de Spearman. De seguida foram aplicados os modelos de regressão pooled OLS e de efeitos fixos ou aleatórios, sendo posteriormente escolhido o modelo mais adequado através dos testes F, Breusch-Pagan e Hausman. Quando analisados individualmente, a maioria dos países apresenta uma correlação positiva entre a liquidez do mercado de capitais e o desenvolvimento económico, sendo consistente com a relação positiva estatisticamente significativa da amostra global apresentada pelos modelos regressivos. Dividida a amostra global pelo nível de desenvolvimento económico dos países e pelo período anterior e posterior à crise económica de 2008, verifica-se existir alterações estatisticamente significativas do impact da liquididez no desenvolvimento económico dos países. Somente os países em desenvolvimento apresentaram uma relação negativa estatisticamente significativa entre as duas dimensões analisadas, contrariamente ao esperado. No entanto, este resultado poderá estar relacionado com as maiores dificuldades na transação de ativos, diminuindo a liquidez e desacelarando o crescimento económico.

Palavras-chave: Liquidez do mercado de capitais; desenvolvimento económico; Índice de Desenvolvimento Humano; Medida de iliquidez de Amihud (2002)

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Abstract

This work analyses the relationship between the stock market liquidity and the country's economic development, which has been object of interest of many researches lately. The stock market liquidity is considered to have a huge impact on a country's economic development. However, all the known studies focused on the economic growth as proxy for the economic development, instead of using a composition of various dimensions to explain the true economic development of a country.

Therefore, the main aim of this work is to contribute to this branch of the literature by using the Human Development Index as proxy for the economic development. The stock market liquidity was calculated based on the Amihud's (2002) illiquidity measure, which is one of the most reliable measures of this area.

This study was carried out based on a wide and diversified sample with 59 countries. The sample period is comprised between 1990 and 2015, with annual frequency data. Firstly, the correlations between the stock market liquidity and economic development are calculated for each country using the Spearman's non-parametric correlation test. Then, were applied the pooled OLS and fixed and random effects regression models, being the most suitable model then chosen through the F, Breusch-Pagan and Hausman tests. When analysed individually, most of the countries have a positive correlation coefficient between the stock market liquidity and economic development, which is consistent with the statistically significant positive relationship when analysing the global sample. Dividing the original sample by the level of economic development of the countries and by the period before and after the economic crisis of 2008, there are statistically significant changes in the impact of the stock market liquidity on the countries' economic development. Only the developing countries presented a statistically significant negative relationship between the two analysed dimensions, contrary to the initial expectations. Still, this result may be related to the greater difficulties in the transaction of assets, reducing liquidity and slowing down economic growth.

Keywords: Stock market liquidity; economic development; Human Development Index; Amihud's (2002) illiquidity measure

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List of symbols and abbreviations

HDI	Human Development Index
GDP	Gross Domestic Product
GNP	Gross National Product
UN	United Nations
GNI	Gross National Income
HDRO	Human Development Report Office
UNDP	United Nations Development Programme
EU	European Union
ASEAN	Association of South-East Asian Nations
G20	Group of 20
USA	United States of America
IV	Instrumental Variables
VAR	Vector Autoregressive
OLS	Ordinary Least Square
ECM	Error Correction Model
ARDL	Autoregressive Distributed Lag
REM	Random Effect Model
FEM	Fixed Effect Model
VECM	Vector Error Correction Model

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1. Introduction

The relationship between the stock market development and the country's economic development has been object of interest of many researchers. Hence, several models composed by various financial and economic variables have been developed to explain the relationship between these two elements. One of the most studied dimensions or proxy of the stock market development on these prediction models is the stock market liquidity, as it is considered to have a huge impact on the stock market development, which in turn is expected to have a positive impact on the economic development of a country.

The relationship between the stock market liquidity and the economic growth was studied by many authors throughout the years, as Levine(1991), Levine & Zervos (1998) and more recently by Rahman & Salahuddin (2010), Meichle, Ranaldo, & Zanetti (2011), Næs, Skjeltorp, & Ødegaard (2011), Florackis, Giorgioni, Kostakis, & Milas (2014), Smimou (2014), Apergis, Artikis, & Kyriazis (2015) e Galariotis & Giouvris (2015), to name a few. However, they all focus on economic growth and not on economic development as a composition of various dimensions like composite indices.

The economic development concept includes but it is not only the economic status of a country. Apart from that, it also takes into account the level of education and the health conditions of its population, for example. Thus, one should not use just a singular variable to capture the economic development but a composite index that includes social dimensions that are part of a country's development.

The most commonly used variables to measure economic development are based on economic measures like Gross Domestic Product (GDP), unemployment rate, productivity, consumption and so on. Therefore, those works were in fact only capturing the economical dimension of a country's development, which is only one part of its economic development. The main aim of this work is, therefore, to contribute to this branch of the literature by analysing the relationship between the stock market liquidity and the economic development by using the Human Development Index (HDI) as proxy for the economic development.

To our best knowledge, there is no study presenting a similar reasoning in terms of the choice of the economic development measurement, thus, this study presents new and significant conclusions about the stock market liquidity impact on the countries' economic development, based on a wide and diversified sample containing 59 countries for the period

1990-2015, which enhances its representativeness. With these, more proactive politics or actions can be adopted by politicians or regulatory entities to stimulate the economic development through the stock market liquidity enhancement.

After this brief introduction the present dissertation is organized as follows. Next chapter presents a literature review, where is presented an overview about the economic development, stock market liquidity and later, an analysis of various papers that studied the relationship between the economic growth and the stock market development. The following chapter presents the methodology applied in this work, namely the sample composition, the chosen variables and the used empirical model. The results are presented on chapter 4 and finally, main conclusions are presented at the end of this dissertation, in the last chapter.

2. Literature review

To understand how economic development and stock market liquidity are linked, a small introduction to each theme is presented below: firstly, the economic development and then the stock market liquidity. Finally, this chapter concludes with several papers that analyse the relationship between the two.

2.1. Economic development

One of the first authors to define and explain economic development was Schumpeter in 1911 in his book "The Theory of Economic Development". Schumpeter identified several factors as being able of influencing economic development, although classifying some of them as secondary like the wars, politic rebellion and cultural or spiritual issues phenomena. In his work, he affirmed that the main contributor to the economic development is the entrepreneur, as its actions are the main instrument to the economic development process and its disturbance. Entrepreneurs have the power of initiating innovative actions and to influence and change consumers' preferences and needs, evolving this way the economic system. To Schumpeter, the entrepreneur does not save money or assets to start producing, instead, he uses capital supplied by the credit mechanisms of bankers or capitalists, which are therefore extremely important to enhance economic development. The discoveries and innovations promoted by the entrepreneurs generate new investment opportunities, creating employment and consequently, promoting growth (Croitoru, 2012; Śledzik, 2015).

Focusing on the underdeveloped economies, Hirschman wrote the "The Strategy of Economic Development" in 1958, aiming to help economists and governments to foster growth of those economies. He states that the less developed economies have limited growth initially due to the lack of ability to invest and in a later phase due to the scarce savings availability. The inability to perceive and carry out investment decisions or to overcome institutional obstacles impedes these economies from developing. To Hirschman, due to the scarce entrepreneurial ability, priorities must be defined in favour of interrelated industrial sectors which, as being related to each other, will enhance consequently the growth of other industries or sectors (Chenery, 1959).

The initial concept of development was therefore perceived as the necessity of increasing a countries' total output along the time. However, some developed countries, in the 1950s and 1960s, realized that the standard of living of their population did not change even though the economic growth goals were being achieved. Governors realized that the increase of the country's output did not radiate mass poverty, illiteracy or diseases. Hence, many economists removed the country's output from the core of the economic development definition to include the focus on the eradication of poverty, illiteracy and diseases and on the enhance of the per capita output growth (Jahangir, 2011).

Economic development is not solely related to economic growth, but also to the improvement in human (or social) development (Birdsall, 1993). Another definition for economic development was proposed by Sen (2001) as he relates the development with people's freedom. He stated that creating freedom for people and removing obstacles to greater freedom is the way to create development. The obstacles to freedom/development could be poverty, corruption, poor governance, lack of economic opportunities, lack of education or lack of health. Hence, the real development is only achieved by creating overlapping mechanisms that can promote the various freedom dimensions. Adelman (2001) affirms that the economic development combines sustainable growth, technological development, structural changes in production patterns and also social, political and institutional upgrading and improvements in human conditions.

Consequently, economic development is nowadays defined as multivariate concept, difficult to be defined in a single satisfactory sentence or to be measured in one single indicator (Jahangir, 2011).

The economic indicators per capita income (GDP per capita) growth was one of the firsts to be used to measure economic development, gaining popularity throughout the time. Due to this and to its easy availability, per capita income is the key indicator to measure the country's economic performance. Using exclusively the GDP per capita growth to explain the economic development of a country has its advantages and disadvantages. It can show in a more comprehensive way if the economy is improving or not, being considered as a proxy for all the economic activity. However, GDP per capita does not consider many economic activities that do not involve money transactions although they have a real impact on the country's economic development. The real nature of those activities or actions is also not considered in this measure, which could be useful of harmful to the society. As this is a quantitative and objective measure, it cannot express the impact of qualitative and subjective

elements like the level of happiness, justice, security, well-being, leisure of freedom of the people. As stated before, the economic development does not only comprehend the economic strand of a country but also the social and political strands. Therefore, to get an overview of the economic development of a country, one should use other social indicators like the literacy level, educational enrolment ratios, life expectancy, maternal or infant mortality rates or the access levels to drinking water and sanitation. Poverty or inequality levels can also be used to describe the social development (Jahangir, 2011).

To minimise the problems of using individual indicators and the risk of not seizing the real development level of a country, is possible to combine a selection of indicators to create a development index. The most popular is the Human Development Index, created by the United Nations (UN).

The main aim of HDI is to highlight that people and their capabilities should be the final criteria to assess the country development, not just economic indicators by themselves. With HDI is possible to understand how two countries with similar income per capita can have different human development results (Human Development Reports, n.d.).

HDI is a resume of three main dimensions of human development: a long and healthy life, having a decent living standard and being knowledgeable. It is a geometric mean of normalized indices for each of the mentioned dimensions (Human Development Reports, n.d.).

The health indicator used is the life expectancy at birth, the educational indicators are the mean of years of schooling for adults with 25 or more years and the expected schooling years for children with school entering age. To measure the standard of living is used the economic indicator Gross National Income (GNI) per capita. Then, the three scores are aggregated into a single index, using a simple geometrical mean (Human Development Reports, n.d.).

Although HDI is a composite index, it does not capture all the human development dimensions, as it does not reflect the effects of inequalities, poverty, security, empowerment, and so on. For those special cases, Human Development Report Office (HDRO) presents other composite indices more focused on inequality, gender disparity and poverty. The HDRO therefore recommends the use and analysis of other human development indicators and information to get a full picture of a country's level of development (Human Development Reports, n.d.).

Figure 1 presents a resume of the HDI content and calculation.

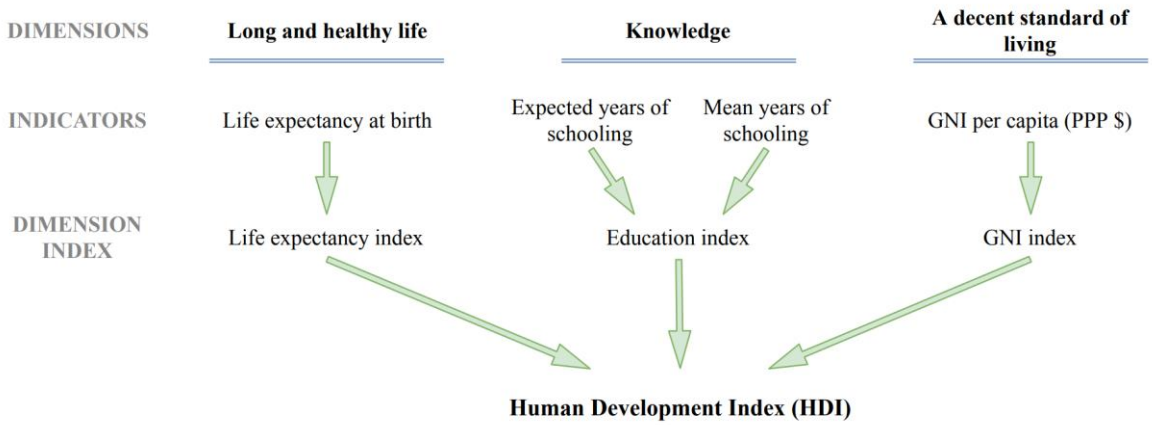

Figure 1 – HDI resume (Human Development Reports, n.d.)

The HDI values for each country since 1990 are available and free on the United Nations Development Programme (UNDP) website, although not all countries have HDI values since that date because of data unavailability.

2.2. Stock market liquidity

The stock market liquidity is related to the volume of transactions, frequency of trading and the price impact (Datar, 2000). In other words, liquidity describes the ease of buying or selling an asset or security without any major fluctuation on price. For example, if a stock has a high trading volume that is not dominated by selling, the bid price and the ask price will be close to each other. Thus, when bid and ask spread gets higher, the stock becomes more illiquid. To simplify, from now on, stock market liquidity will be referred only as liquidity.

Relative spread is the difference between ask and bid prices and it reflects the cost of immediacy. It measures the implicit cost of trading shares and it is calculated as the quoted spread (the difference between the best bid and ask prices) as a fraction of the midpoint price (the average of the best bid and ask prices).

$$RS_{i,T} = \frac{\sum_{t=1}^{T} \frac{(p_{i,t}^{ASK} - p_{i,t}^{BID})}{(p_{i,t}^{ASK} + p_{i,t}^{BID})/2}}{D_T} \tag{2.1}$$

Where D_T is the number of observations (or observed days), $p_{i,t}^{ASK}$ and $p_{i,t}^{BID}$ is respectively the ask and bid price at day t for stock i. Overall, relative spread is an illiquidity

measure, as the higher the value, the more illiquid the stock due to large implicit costs of trading.

Lesmond, Ogden, & Trzcinka (1999) developed a measure of the transaction costs, based on daily returns, thus, independent from the quotations or the order book. The authors use the frequency of zero returns to determine an implicit cost of trading required for a stock's price not to move while the market return changes. To explain this measure nature, they use the market model (2.2).

$$R_{it} = a_i + b_i R_{mt} + \varepsilon_{it} \tag{2.2}$$

Where R_{it} is the return of security i on time t, R_m is the market's return at time t, a and b are respectively a constant term and a regression coefficient and ε an error term. If the market return changes, the security's return should also change according to the above equation. But if it does not, it may indicate that the trading cost might be higher than the price movement that should have occurred. To identify this "zero return" moments, the authors define cost bands around the stock price and consider that the wider the cost band, more illiquid is the security.

In 1984, Roll published an estimate of the implicit spread called effective bid-ask spread. This measure differs from the standard bid-ask spread by using the serial covariance of successive price movements. The estimator is defined as present below.

$$\hat{s} = \sqrt{-S\,\mathrm{cov}} \tag{2.3}$$

Where $\hat{s}$ is assumed to be a constant effective spread and Scov is the first order serial covariance of successive returns.

For some markets, some microstructure data on transactions and quotes are not available for long time periods. To overcome this problem, Amihud (2002) developed an illiquidity measure that uses daily data on returns and volume of transactions, that is available for most of the markets over long time periods. The author computed the stock illiquidity as the average ratio of daily absolute return to the (dollar) trading volume on that day.

$$ILLIQ_{iy} = \frac{\sum_{t=1}^{Diy} \left| R_{iyd} \right| / VOLD_{iyd}}{D_{iy}} \tag{2.4}$$

Where D_{iy} is the number of days with data available for stock *i* in year *y*, R_{iyd} is the return of stock *i* on day *d* of year *y* and $VOLD_{ivyd}$ is the respective daily volume in dollars. The reason that it is called an illiquidity measure is that a high value indicates a high price impact of trades which leads to low liquidity. So, this ratio shows the price changes percentage in relation to the daily trading volume.

The following measures can be used to measure both the stock market liquidity as well as the stock liquidity. The turnover ratio and value of traded shares ratio are two of the most used liquidity measures, mainly due to its calculus simplicity. The first is calculated dividing the total value of the traded shares on the stock exchange by the total value of listed shares on the stock exchange. The second is defined by the ratio between the total value of traded shares on the stock exchange and the GDP.

Goyenko, Holden, & Trzcinka (2009) evaluated the performance of various liquidity measures, including the ones cited before, and concluded that the measures based on daily data deliver good estimations of high frequency transaction costs benchmarks. They also state that more recently, apart the Amihud's (2002) illiquidity measure and the Lesmond, Ogden, & Trzcinka (1999) estimator, the performance of all measures deteriorated.

2.3. Economic growth and liquidity

The majority of the authors are focused on how the stock market or banking development influences the economic growth, studying these areas together (Anyamele, 2010; Beck & Levine, 2004; Caporale, Howells, & Soliman, 2004; Næs et al., 2011; Pradhan, Arvin, Hall, & Bahmani, 2014; Wu, Hou, & Cheng, 2010; Zhu, Ash, & Pollin, 2004). Only a few, study the stock market development effect on the economic development in depth, using various measures for the same issue, trying to capture all the effects of a specific dimension (Apergis et al., 2015; Florackis et al., 2014; Levine & Zervos, 1998; Næs et al., 2011; Smimou, 2014). Stock market liquidity is one of the main dimensions used to define the stock market development. Many have studied the linkage between liquidity and the economic growth and its causality direction, i.e. which one influences the other: if it is liquidity that lead to economic growth, vice-versa or even if both can enhance each other (Carp, 2012; Enisan & Olufisayo, 2009; Galariotis & Giouvris, 2015; N'Zué, 2006; Næs et al., 2011; Nurudeen, 2009; Pradhan, Arvin, & Ghoshray, 2015; Pradhan et al., 2014;

Ramkelawon, Khan, & Sunecher, 2015; Rousseau & Wachtel, 2000; Smimou, 2014; Srinivasan, 2014).

Although there are so many authors trying to explain how these two dimensions are linked together (Carp, 2012; Enisan & Olufisayo, 2009; Galariotis & Giouvris, 2015; N'Zué, 2006; Næs et al., 2011; Nurudeen, 2009; Pradhan et al., 2015, 2014; Ramkelawon et al., 2015; Rousseau & Wachtel, 2000; Smimou, 2014; Srinivasan, 2014), there is no consensus about which liquidity measure and economic development variable reveal or characterise better the information contained in both dimensions and how they are linked. This tendency extends to the methodologies applied by the various authors, which lead to different conclusions about if stock market liquidity impacts on economic growth or vice-versa and about the impact of each other and its relevance. The countries included in the sample and the time span selected by the authors also vary considerably, which can be other reason for the results' inconsistencies.

One of the first endogenous models about the relationship between the stock market and the economic growth was developed by Levine in 1991, that also encompassed the tax policy effect. The conclusions are that the stock market can promote growth by facilitating the ability of trading firms' ownerships without disrupting its productivity and allowing investors to have a diverse portfolio. Thus, a liquid stock market can promote the investment on high return projects and hence stimulating earnings and productivity growth, by lowering the cost of capital.

Since Levine (1991) several other studies have been published on the topic, the majority of which state that there is a positive relationship between the economic development/growth and the stock market liquidity (Ahmad, Etudaiye-Muhtar, Matemilola, & Bany-Ariffin, 2016; Apergis et al., 2015; Beck & Levine, 2004; Caporale et al., 2004; Carp, 2012; Castillo-Ponce, Rodriguez-Espinosa, & Gaytan-Alfaro, 2015; Cooray, 2010; Enisan & Olufisayo, 2009; Florackis et al., 2014; Levine & Zervos, 1998; Meichle et al., 2011; Næs et al., 2011; Ngare, Nyamongo, & Misati, 2014; Nowbutsing & Odit, 2009; Pradhan et al., 2015, 2014; Rahman & Salahuddin, 2010; Rousseau & Wachtel, 2000; Smimou, 2014; Srinivasan, 2014; Wu et al., 2010). The time span analysed by these authors vary significantly, both in terms of starting and ending years - Næs et al. (2011) captured data since 1947 whereas Srinivasan (2014) analysed the data available until 2013 – as well as its length that diverge from 11 years (Cooray, 2010) to 61 years (Næs et al., 2011). However, most of them examine data of 20 to 30 years, mainly after 1975.

The composition and length of the sample differ a lot between the various studies. For example, the biggest samples have 47 countries (Levine & Zervos, 1998; Rousseau & Wachtel, 2000), followed by Beck & Levine (2004) and Cooray (2010) that analysed 40 and 35 countries, respectively. There are also some authors that studied only one country, for instance, Cote D'Ivoire by N'Zué (2006), Nigeria by Nurudeen (2009), Mauritius by Nowbutsing & Odit (2009), Pakistan by Rahman & Salahuddin (2010), Switzerland by Meichle et al. (2011), Romania by Carp (2012), India by Srinivasan (2014), United Kingdom by Florackis et al. (2014),Canada by Smimou (2014) or Mexico by Castillo-Ponce et al. (2015). Other studies focus on a specific group of countries, for example Ahmad et al. (2016), Enisan & Olufisayo (2009) and Ngare et al. (2014) that studied only African countries, Wu et al. (2010) that analysed 13 European Union (EU) countries, Pradhan et al. (2014) that studied the 26 countries of the Association of South-East Asian Nations (ASEAN) regional forum or Pradhan et al. (2015) with the 19 countries with biggest economies plus the EU (G20).

In terms of the variables used, to measure the economic development/growth, most of the authors tend to use the GDP in various forms – real or nominal, total or per capita, growth percentage, logarithm form or even dividing it by levels. Others use a derived form of it, together with other variables like capital stock growth, productivity growth and savings (Levine & Zervos, 1998) or the real consumption, real investment and unemployment rate (Apergis et al., 2015; Næs et al., 2011) or even with the industrial production and market returns (Smimou, 2014). Srinivasan (2014) used only the industrial production as proxy to study the impact of the stock market on the Indian's economic development.

Relatively to the liquidity measures, approximately half of the authors use only one variable to characterize the stock market liquidity, whilst the other half test the relationship of two, three or even four variables. The most commonly used ones are the turnover ratio, value of shares traded ratio and Amihud's (2002) illiquidity measure. The first two were applied in both newer and older articles (for example in Ahmad et al. (2016), Apergis et al. (2015), Levine & Zervos (1998), Pradhan et al. (2015), Rousseau & Wachtel (2000) or Zhu et al. (2004)) while the later were only applied in newer studies (as it became more popular and due to its later appearance).

Lastly, many control variables were used in the analysed papers where each one applies mainly between three to seven different variables in its study. Meichle et al. (2011) even apply 36 variables in total (including the dependent variables which in some tests are

used as control variables). These are predominantly measures of other dimensions of the stock market - for example, capitalization, market returns, volatility, etc. - (Caporale et al., 2004; Enisan & Olufisayo, 2009; Galariotis & Giouvris, 2015; Levine & Zervos, 1998; Nowbutsing & Odit, 2009; Zhu et al., 2004), bank sector (Ahmad et al., 2016; Anyamele, 2010; Pradhan et al., 2014) or country's economy - for example schooling enrolment, government expenditures, unemployment rate, private and public investment, etc. - (Hou & Cheng, 2017; Matadeen & Seetanah, 2015; Ngare et al., 2014; Rahman & Salahuddin, 2010; Ramkelawon et al., 2015; Smimou, 2014). It is also commonly used the lagged dependent variable (Adjasi & Biekpe, 2006; Apergis et al., 2015; Florackis et al., 2014; Ngare et al., 2014) or other measures of the economic development of the studied country or even other main economies, mainly the United States of America (USA) (Florackis et al., 2014; Smimou, 2014).

In terms of the chosen methodology, it seems that there is no consensus of which one is better to determine the relationship between the country's economic development and the respective stock market. The most commonly used, but only applied in four articles each, were the Instrumental Variables (IV) (Apergis et al., 2015; Levine & Zervos, 1998; Næs et al., 2011; Smimou, 2014) and the Vector Autoregressive (VAR) models (Caporale et al., 2004; Carp, 2012; Pradhan et al., 2015; Rousseau & Wachtel, 2000). Many variations of least square regressions were also applied (Beck & Levine, 2004; Levine & Zervos, 1998; Ngare et al., 2014) and to analyse the causality between the variables, the majority of the authors gave preference to the Granger causality test (Carp, 2012; Enisan & Olufisayo, 2009; Næs et al., 2011; Nowbutsing & Odit, 2009; Pradhan et al., 2015, 2014; Rousseau & Wachtel, 2000; Smimou, 2014; Srinivasan, 2014).

In terms of conclusions of these studies, as mentioned before, there is no consensus. N'Zué (2006) and Nurudeen (2009), for example, concluded that the stock market liquidity has a statistically significant negative impact on the country's economic development. Studying, respectively, Cote D'Ivoire between 1976 to 2002 and Nigeria between 1981 to 2007, using similar dependent variables (the first used economic growth while the later the real GDP) and liquidity variables (N'Zué (2006) used the turnover ratio whereas Nurudeen (2009) applied the market turnover over GDP), both verified that exists a negative impact of the stock market liquidity on the economic growth. In terms of control variables, N'Zué (2006) focused more on measuring other dimensions of the government policy while Nurudeen (2009) used four other variables that measured the Nigerian stock market

development. The first used an Ordinary Least Square (OLS) model while the second an Error Correction Model (ECM), though, both applied the Granger causality test.

Contrarily to the previously mentioned authors, Zhu, Ash, & Pollin (2004) and Anyamele (2010) did not find any statistically significant relationship between the stock market liquidity and the chosen samples. Using OLS and IV methods, with the output, capital stock and productivity growth and savings as dependent variables, the turnover and value of traded shares ratios and other measures of stock market bank development as control variables, Zhu, Ash, & Pollin (2004) did not find any significant conclusion about this relationship. The same happened with Anyamele (2010) when applying the OLS method with real GDP per capita as the dependent variable, turnover ratio as liquidity measure and other measures of stock market, bank and economic development as control variables.

There are also some authors that got different conclusions when using different variables, methods, countries or sub-samples (divided by various conditions) (Adjasi & Biekpe, 2006; Cheng, 2012; Galariotis & Giouvris, 2015; Hou & Cheng, 2017; Matadeen & Seetanah, 2015; Ramkelawon et al., 2015). For example, using a sample composed by 14 African countries and the same methodology as Levine & Zervos (1998) during the period 1975-2001, Adjasi & Biekpe (2006) found that when the turnover ratio is used as liquidity measure, stock market liquidity does not play a significant role on the economic growth, whereas when using the value of traded shares ratio, it has a positive impact on it. Cheng (2012) found that in Taiwan, stock market liquidity had a positive impact on the economic growth before the financial openness in 1982. However, it turned negative afterwards, possibly due to the excess of liquidity caused by noise traders, which did not allow country's economy to develop. The author applied a VAR model, during the period 1973-2007, with real GDP in logarithm form as the dependent variable, turnover ratio as liquidity measure and three other financial measures as control variables. Ramkelawon et al. (2015) and Matadeen & Seetanah (2015), when studying the Mauritius's stock market liquidity during the years 1989-2011 and 1988-2011, respectively, using the GDP as the dependent variable and the liquidity measures turnover ratio and value of traded shares ratio, had different conclusions when applying different methodologies or different forecasts . The first, applying the Autoregressive Distributed Lag (ARDL) method found that the liquidity had a negative impact on the Mauritius GDP, whereas when applying an ECM, the impact turned out to be positive. The second, concluded that in the long run, the stock market liquidity would have a positive impact on the GDP, while in the short run it has no significance. In

2015, Galariotis & Giouvris studied the stock market liquidity of Canada, France, Germany, Italy, Japan, UK and USA by means of the use of an IV model during the period 1995-2013. Using the GDP, unemployment rate, personal consumption and private investment as dependent variables and the Amihud's (2002) illiquidity measure and the (Roll, 1984) spread to replicate the stock market liquidity (these were used separately), the authors got different results depending on the country that were studying and liquidity measure chosen. Lastly, Hou & Cheng (2017) applied an ECM on 31 countries during the period 1981-2008 and concluded that the relationships vary when dividing the sample by low and high GNI or by low and high financial development and for different forecasts. For example, the stock market liquidity has a positive impact on the low GNI group in the long run, whereas for the same forecast but with the high GNI sub sample this relationship is not significant.

To resume all the literature review presented above, Table 1 and Table 2 present the main information about the mentioned articles.

Table 1 - Literature review resume (conclusive results)

Liquidity - Development Relation	Author(s) (Year)	Time Interval	Sample	Dependent Variables	Liquidity Measures	Control Variables	Methodology
Positive	**Levine and Zervos (1998)**	1976-1993	47 countries	Output Growth Capital Stock Growth Productivity Growth Savings	Turnover Ratio Value of Shares Traded Ratio	Market Capitalization to GDP Volatility CAPM Integration APT Integration Bank Credit	OLS IV
	Rousseau and Watchel (2000)	1980-1995	47 countries	GDP (real, per capita growth)	Value of Shares Traded Ratio	Initial Real GDP per Capita Secondary Enrollment Rate Black Market Exchange Rate One of 3:Liquid Liabilities (M3), Market Capitalization or Total Value Traded	VAR (fixed effects) Granger Causality
	Beck and Levine (2004)	1976-1998	40 countries	GDP (real, per capita)	Turnover Ratio	Initial GDP per Capita Schooling Years Average Government Consumption Trade Openness Inflation Rate Black Market Premium Bank Credit	OLS Generalized Method of Moments
	Caporale, Howells and Soliman (2004)	1977-1998	Argentina, Chile, Greece, South Korea, Malaysia, Philippines and Portugal	GDP (in levels)	Value of Shares Traded Ratio	Market Capitalization to GDP Bank Deposit Liabilities to Nominal GDP Ratio of Bank Claims on the Private Sector to Nominal GDP	VAR (Toda and Yamamoto (1995))
	Enisan and Olufisayo (2009)	1980-2004	Cote D'Ivoire, Egypt, Kenya, Morocco, Nigeria, South Africa, and Zimbabwe	GDP (nominal, per capita)	Value of Shares Traded Ratio	Market Capitalization to GDP Discount Rate Openness Ratio Reserve Requirements Open Market Operation	ARDL Granger causality
	Nowbutsing and Odit (2009)	1989-2006	Mauritius	GDP (per capita)	Value of Shares Traded Ratio	Market Capitalization to GDP Foreign Direct Investment Secondary Enrollment Ratio	Two Step Procedure of Engle and Granger
	Cooray (2010)	1992-2003	35 countries	GDP (per capita)	Turnover Ratio Value of Shares Traded Ratio	Share of Investment to GDP Annual Average Growth Rate of Labour Force Average Population Growth Rate Net Secondary Enrollment Ratio Net Primary Enrollment Ratio Stock Market Capitalization	MRW Model (Mankiw, Romer and Weil, 1992)

Table 1 - Literature review resume (conclusive results) (Cont.)

Liquidity - Development Relation	Author(s) (Year)	Time Interval	Sample	Dependent Variables	Liquidity Measures	Control Variables	Methodology
Positive	**Rahman and Salahuddin (2010)**	1971-2006	Pakistan	GNP (real, per capita)	Value of Shares Traded Ratio	Market Capitalization to GDP Financial Development Financial Instability Inflation Rate Foreign Direct Investment Literacy Rate	ARDL (Pesaran et al. (2001)) ECM
	Wu, Hou and Cheng (2010)	1976-2005	13 EU countries	GDP (real, logarithm)	Turnover Ratio	Ratio of Liquid Liabilities Ratio of Deposit Money Ratio of Market Value	ECM
	Naes, Skjeltorp and Odegaard (2011)	1947-2008	Norway and USA	GDP (real) Unemployment rate Real Consumption Real Investment	Amihud (2002) Roll (1984) Relative Spread Lesmond, Ogden and Trczinka (1999)	Excess Market Return Market Volatility Term Spread Credit Spread	IV Granger Causality
	Meichle, Ranaldo and Zanetti (2011)	1975-2010	Switzerland		Amihud (2002) Turnover Ratio	36 variables (in total)	Probit Regression
	Carp (2012)	1995-2010	Romania	GDP (growth)	Turnover Ratio	Market Capitalization to GDP Stock Value Traded Real Investment	VAR Granger Causality
	Ngare, Nyamongo and Misati (2014)	1980-2010	18 African countries	GDP (real, per capita growth)	Turnover Ratio	Lagged Real GDP per Capita Inflation Rate Gross Primary School Enrolment Rate Gross Investment Trade Openness Quality of Institutions Stock Market Dummy	Pooled Model Random Effect Model (REM) Fixed Effects Model (FEM)
	Pradhan, Arvin, Hall and Bahmani (2014)	1961-2012	ARF-26	GDP (per capita growth)	Turnover Ratio	Foreign Direct Investment Trade Openness Inflation Rate Government Final Consumption Expenditure Banking Sector Development Stock Market Development	VECM Granger Causality
	Srinivasan (2014)	1991-2013	India	Industrial Production	Turnover Ratio	Stock Market Capitalization	ARDL Granger Causality
	Florackis, Giorgioni, Kostakis and Milas (2014)	1989-2012	UK	GDP (growth)	Amihud (2002) Florackis et al. (2011)	Lagged GDP Growth Term Spread Real Money Growth Real GDP Growth Rate of USA	Regime Switching Model

Table 1 - Literature review resume (conclusive results) (Cont.)

Liquidity - Development Relation	Author(s) (Year)	Time Interval	Sample	Dependent Variables	Liquidity Measures	Control Variables	Methodology
Positive	**Smimou (2014)**	1986-2011	Canada	GDP Industrial Production Market Returns	Amihud (2002) Relative Spread Open Interest	GDP Growth Unemployment Rate Inflation Rate Real Personal Consumption Retail Sales Change in Oil Price Change in US Dollar - Canada Dollar Currency Rate Change in Consumer Credit Change in Consumer Attitudes	IV Granger Causality
	Pradhan, Arvin and Ghoshray (2015)	1961-2012	G20 countries	GDP (real, per capita growth)	Turnover Ratio Total Value Traded	Market Capitalization Percentage Change Traded Stocks Crude Oil Prices Real Effective Exchange Rate Inflation Rate Real Interest Rate	VAR Vector Error Correction Model (VECM) Granger Causality
	Apergis, Artikis and Kyriazis (2015)	1994-2011	UK and Germany	GDP (real, growth) Real Consumption (growth) Real Investment (growth) Unemployment Rate (growth)	Amihud (2002) Turnover Ratio Relative Spread Total Value Traded	Housing Starts Term Spread Market Risk Premium Stock Market Volatility Short-term Interest Rate Default Spread Lagged Dependent Variable	Toda-Yamamoto Causality IV
	Castillo-Ponce Rodriguez-Espinosa and Gaytan-Alfaro (2015)	1993-2011	Mexico	GDP (real)	Value of Stocks Level of Operations Value/GDP Operations/GDP	Stock Prices Index Industrial Production	Common Cycle Methodology
	Ahmad, Etudaiye-Muhtar, Matemilola and Bany-Ariffin (2016)	1987-2012	9 African countries	GDP (real, per capita growth)	Turnover Ratio	Market Capitalization to GDP Bank Credit Inflation Rate Trade Openness Financial Crisis Dummy Gross Investment Government Consumption Expenditure Real Interest Rate	Pooled Mean Group

Table 1 - Literature review resume (conclusive results) (Cont.)

Liquidity - Development Relation	Author(s) (Year)	Time Interval	Sample	Dependent Variables	Liquidity Measures	Control Variables	Methodology
Negative	**N'Zué (2006)**	1976-2002	Cote D'Ivoire	Real Growth	Turnover Ratio	Market Capitalization Four-firm Concentration Government Expenditure Public Investment Public Development Aid Foreign Direct Investment Inflation	OLS Granger Causality
	Nurudeen (2009)	1981-2007	Nigeria	GDP (real)	Market Turnover (by GDP)	Market Capitalization (over GDP) Openness (over GDP) Minimum Discount Rate Nigerian Stock Market Index	ECM Granger Causality
Not Significant	**Zhu, Ash and Pollin (2004)**	1976-1993	47 countries	Output Growth Capital Stock Growth Productivity Growth Savings	Turnover Ratio Value of Shares Traded Ratio	Market Capitalization Volatility CAPM Integration APT Integration Bank Credit	OLS IV
	Anyamele (2010)	1992-2002	Sub-Saharan Africa	GDP (real, per capita)	Turnover Ratio	Market Capitalization Private Capital Formation Private Bank Credit Inflation Rate Government Consumption	OLS FEM

Table 2 - Literature review resume (non-conclusive results)

Author(s) (Year)	Time Interval	Sample	Dependent Variables	Liquidity Measures	Control Variables	Methodology	Remarks
Adjasi and Biekpe (2006)	1975-2001	14 African countries	GDP (per capita growth)	Turnover Ratio Value of Shares Traded Ratio	Market Capitalization to GDP Lagged GDP per Capita Growth Rate Investment Trade	Levine and Zervos (1996)	Turnover Ratio - Not Significant Value of Shares Traded - Positive
Cheng (2012)	1973-2007	Taiwan	GDP (real, logarithm)	Turnover Ratio	Debt-to-equity Ratio Volatility Bond Market	VAR Weak Exogeneity Test (causality)	Pre-openness - Positive Post-openness - Negative
Ramkelawon, Khan and Sunecher (2015)	1989-2011	Mauritius	GDP (real, per capita)	Turnover Ratio Value of Shares Traded Ratio	Foreign Direct Investment Secondary Enrollment Ratio Real Rate of Interest Stock Market Development Indicator	ARDL ECM Granger Causality	ARDL - Negative ECM - Positive
Galariotis and Giouvris (2015)	1995-2013	Canada, France, Germany, Italy, Japan, UK and USA	GDP (real, growth) Unemployment Rate (growth) Real Personal Consumption (growth) Real Private Fixed Investment (growth)	Amihud (2002) Roll (1984)	Term Spread Momentum Small Minus Big (Fama and French, 1993) High Minus Low (Fama and French, 1993) Dividends Risk Free Rate Excess Market Return	IV Dumitrescu Hurlin Causality Granger Causality	Results depend on the country, tested variable and time
Matadeen and Seetanah (2015)	1988-2011	Mauritius	GDP	Turnover Ratio Value of Shares Traded Ratio	Market Capitalization Ratio Domestic Credit to Private Sector Trade Openness Country's Gross Fixed Capital Foreign Direct Investment Tertiary Enrolment Ratio	VECM	Long Run - Positive Short Run -Not Singnificant
Hou and Cheng (2017)	1981-2008	31 countries	GDP (per capita growth)	Turnover Ratio	Private Credit Life Insurance Penetration Exports+Imports to GDP Ratio Government Consumption to GDP Ratio	ECM PGM Estimators	Low GNI, Long Run - Positive High GNI, Long Run - Not Significant Short run - Not Significant Low FD, Long Run - Negative

3. Methodology

In this chapter research hypotheses are presented and justified, as well as the empirical model chosen to test them. It starts with the presentation of the three analysed hypotheses related with the relationship between economic development and stock market liquidity, followed by the empirical model presentation, its constituent variables and calculation formulas as well as the applied methodology. In the last sub-chapter, the sample is presented and analysed by means of its descriptive statistics.

3.1. Research hypotheses

As previously mentioned, the main aim of this study is to examine the relationship between the stock market liquidity and the countries' economic development. Thus, the first hypothesis is the following:

H_1: The stock market liquidity has a positive impact on the countries' economic development.

Following the reasoning of Schumpeter in 1911, the key factor for the development is a well-developed financing system. Being the stock market a financing system, its development is extremely important for the companies that use them to obtain credit. One of the most used stock market development indicators is the stock market liquidity, being positively associated with the development level. This assumption meets the initial beliefs of many similar studies like for instance Carp (2012), Galariotis & Giouvris (2015), Næs et al. (2011), Pradhan, Arvin, & Ghoshray (2015), Ramkelawon, Khan, & Sunecher (2015), Rousseau & Wachtel (2000) or Smimou (2014), although several other have reached different conclusions.

After this analysis, the original sample is divided in two different ways in order to comprehend if there is any difference between the relationship behaviour and if the initial beliefs are correct across all countries and/or set of countries. The first, similarly to the Adjasi & Biekpe (2006), and Hou & Cheng (2017) works, aims to examine if the stock market liquidity affects differently the countries' economic development depending on the countries' development classification, although these two studies present opposite conclusions. The second analysis is relatively to the 2008's financial crisis impact and aim

to verify if the stock market liquidity impact on the economic development of its country is different before and after that crisis. After a crisis of this magnitude, is expected that the investors get more cautious due to the big losses that most of them suffered during the crisis. This leads to less and more pondered transactions, which therefore decrease the stock market liquidity. Resuming, the other two hypotheses tested are defined as follows:

H_2: The relationship between the stock market liquidity and the economic development is different between the developed countries and the developing countries;

H_3: The relationship between the stock market liquidity and the economic development is different before and after the great financial crisis of 2008.

3.2. Empirical model and research variables

As stated before, the main aim of this study is to evaluate the impact of the stock market liquidity on the country's economic development, defining for that the HDI coefficient as the dependent variable and the logarithm of the inverse of the Amihud's (2002) illiquidity measure as the main independent variable, along with other control variables.

In order to check if the stock market liquidity is related with the country's development level and to answer to the first research hypothesis stated above, one has to verify the non-parametric correlation between the main variables, namely the HDI coefficient and the stock market liquidity for each country. This correlation is evaluated by means of the Spearman's correlation test. The Spearman's correlation coefficient or Spearman's rho is a nonparametric test to check if the two examined variables have a monotonic behaviour, this is, if the relationship can be described by a monotonic function. The results are between -1 and 1, where -1 indicates a perfect negative monotone correlation, 1 indicates a perfect positive monotone correlation and 0 no correlation at all. This test is done using IBM SPSS software. Besides studying the nature of the correlation between the two variables, a significance test will be applied to check if the hypothetic correlations are statistically significant or not, this is, if they are reliable or not.

Additionally, and following the reasoning of the base models presented namely by Ahmad et al. (2016), Apergis et al. (2015), Florackis et al. (2014) or Galariotis & Giouvris (2015), the empirical model developed to analyse the relationship between a country's the economic development and the stock market liquidity is given as follows:

$$HDI_{i,t} = \alpha + \beta_1 LIQ_{i,t-1} + \beta_2 MC_{i,t-1} + \beta_3 GDP_{i,t-1} + \beta_4 MYS_{i,t-1} + \beta_5 LE_{i,t-1} + \varepsilon_{i,t} \quad (3.1)$$

Where $HDI_{i,t}$ is the HDI value of the current year of the country i, $\beta_1, \ldots, \beta_5$ are the estimation coefficients for each variable, $LIQ_{i,t-1}$ is the stock market liquidity value of the country i of the previous year, $MC_{i,t-1}$ is the market capitalization over the GDP of the country i of the previous year, $GDP_{i,t-1}$ is the logarithm of real GDP per capita of country i of the previous year, $MYS_{i,t-1}$ is the mean years of schooling logarithm of the country i of the previous year and $LE_{i,t-1}$ is the life expectancy at birth logarithm of the country i of the previous year. Finally, $\varepsilon_{i,t}$ is the regression error term.

The dependent variable ($HDI_{i,t}$) is applied directly in the model in its effective value, as it consists of an index number. Data source for this variable is the UNDP website database, as mentioned before.

The liquidity measure applied on this study is based on the Amihud's (2002) illiquidity measure ($LIQ_{i,t-1}$). This measure has been used lately in similar studies, presenting statistically significant results (Apergis et al., 2015; Florackis, Gregoriou, & Kostakis, 2011; Meichle et al., 2011; Næs et al., 2011; Smimou, 2014). Also, as cited before, it is one of the few measures that still represents faithfully the stock market liquidity when using more recent data (Goyenko et al., 2009). Also, contrary to the turnover or the total value traded measures, the Amihud's (2002) illiquidity measure takes into account not only the traded volume but also the price impact. In this work, it is calculated as presented before on equation (2.4).

First, we calculated the absolute daily returns using the Datastream indices prices in US dollars of each stock market. Then the daily returns are divided by the respective monetary daily volume. Finally, all the resultant terms are summed up and divided by the total number of trading days to give the annual illiquidity measurement of the respective country. The stock market indices' daily prices and the monetary daily volume were gathered from the Datastream database. Due to the tiny resultant values (with 10 to 12 decimal places) compared to the other variables' values, the annual values needed to be resized. So, in this case was applied the base-10 logarithm of the inverse value. In this way, although using an illiquidity measure, as it is inverted, in the end it is read as a liquidity measure. Therefore, in our model, this measure will be interpreted as a liquidity measure, i.e. the bigger the value the more liquid is the stock market: a positive regression coefficient means that the economic development is positively related with the stock market liquidity and vice-versa. Thus,

considering our research hypotheses H_1 the regression coefficient for the liquidity measure in our model is expected to be positive.

In terms of control variables, the market capitalization ($MC_{i,t-1}$) used in this model is not presented in absolute values. In order to have a more balanced model in terms of regression coefficients' numerical dimensions, this measure is divided by the respective country's annual real GDP in constant 2010 US dollars. This modification was also applied by Adjasi & Biekpe (2006), Ahmad et al. (2016), Carp (2012), Matadeen & Seetanah (2015), Pradhan et al. (2015), Rahman & Salahuddin (2010) and others. This ratio represents the stock market size and is expected to be positively correlated with the economic development. Its increase is related with the stock market efficiency increase, permitting more capital mobilization and risk diversification (Srinivasan, 2014). The annual market capitalization values were gathered from the Datastream database while the real annual GDP values were taken from the World Bank database.

The $GDP_{i,t-1}$ is defined as the base-10 logarithm of the real GDP per capita in thousands of US dollars. The values were gathered from the database in constant 2010 US dollars. The logarithm is needed to reduce the values' order to a smaller size. This variable was used in almost all reviewed articles mainly as dependent variable to proxy for the economic growth, both with nominal and real values and as total or per capita terms (Apergis et al., 2015; Beck & Levine, 2004; Enisan & Olufisayo, 2009; Næs et al., 2011; Rousseau & Wachtel, 2000; Zhu et al., 2004) but it was also applied as a lagged control variable in various works in various forms as well (Apergis et al., 2015; Florackis et al., 2014; Ngare et al., 2014; Rousseau & Wachtel, 2000; Smimou, 2014). A positive growth of the country's production is expected to have a positive impact on its development, thus, this measure is expected to have a positive relationship with the dependent variable. The required data was gathered from the World Bank database.

As the economic development accounts for the economic, health and educational dimensions, were also included indicators of the two later dimensions in the model as control variables. Hence, the social dimension was measured with two different indicators: for the education dimension, the mean years of schooling logarithm ($MYS_{i,t-1}$) were used and for health the life expectancy at birth logarithm ($LE_{i,t-1}$). The first refers to the mean years of education received by people with 25 years old or more. This indicator was already applied in a previous study done by Beck & Levine (2004) and is one of the base constituents of the HDI coefficient. In terms of the health measure, the life expectancy is defined as the number

of years a new-born could expect to live if prevailing patterns of age-specific mortality rates stay equal to the time of birth throughout his life. Similarly to the education indicator, this is also a base constituent of the HDI coefficient. The source of both indicators is the UNDP website database. Both are expected to have a positive correlation with the HDI of a country (Human Development Reports, n.d.).

To verify the prepositions of the hypothesis H_2 and H_3, was applied a model similar to the one presented in the equation (3.1) with a dummy variable. This dummy variable permits us to test the differences between each group on each analysis. The model is as follows:

$$\begin{aligned} HDI_{i,t} &= \alpha^1 + \beta_1^1 LIQ_{i,t-1} + \beta_2^1 MC_{i,t-1} + \beta_3^1 GDP_{i,t-1} + \beta_4^1 MYS_{i,t-1} + \beta_5^1 LE_{i,t-1} + \\ &+ D*(\alpha^2 + \beta_6^2 LIQ_{i,t-1} + \beta_7^2 MC_{i,t-1} + \beta_8^2 GDP_{i,t-1} + \beta_9^2 MYS_{i,t-1} + \beta_{10}^2 LE_{i,t-1}) + \varepsilon_{i,t} \end{aligned} \quad (3.2)$$

Where $\beta_1, \ldots, \beta_5$ are the estimation coefficients of the first subgroup, $\beta_6, \ldots, \beta_{10}$ are the change of the coefficient values between the first and the second subgroups and D is the dummy variable that can take a value of 0 or 1 depending on the observation. The independent variables are equal to the ones mentioned before. In the economic development analysis, the developing countries sample is the first subgroup while the developed countries sample is the second subgroup. This way, with the model presented on equation (3.2), one can verify if the relationship between the economic development and the stock market liquidity is statistically significantly different between developing and developed countries, answering to the hypothesis H_2. In the 2008 crisis impact analysis, the pre-crisis era is defined as the first group and the post-crisis era as the second group. Similarly to the previous reasoning, using the model of equation (3.2), one can verify if the relationship between the economic development and the stock market liquidity is statistically significantly different before and after the 2008 economic crisis, answering to the hypothesis H_3.

As the data for all the variables above were gathered for several countries and different years, consisting therefore on a panel data, the empirical model is solved in three distinct ways: applying the pooled OLS, fixed effects model and random effects model. Using the F, Breusch-Pagan and Hausman tests the most appropriate of the three models was chosen.

3.3. Sample

The data covers the years from 1990 to 2015 and included annual observations. Although this can be pointed as a limitation of this study, it was imposed by data availability, specifically due to the HDI values that are only presented in annual values on the UNDP website.

The sample was initially composed by all countries available on the UNDP website with HDI values, making a total of 188 countries. However, because not all of them have its own stock market, 43 countries were excluded, decreasing the sample to 143 countries.

In order to have a minimum quantity of observations to get credible and significant results, countries with HDI values for less than 10 years were also excluded. Similarly, the countries with a stock market younger than 10 years were left out as well. So, with the first restriction were eliminated 9 countries, whereas other 2 were also excluded due to the second restriction, decreasing the sample to 134 countries.

Finally, the total sample was then reduced to 59 countries due to data availability constraints of the DataStream database. To our best knowledge, the sample used in this work is the biggest among all the reviewed studies, presenting a considerable countries diversification in terms of geographical location and economic status, increasing consequently the general representation of the obtained results.

Table 3 presents the final sample grouped by the countries' development level defined by the World Bank for the civil year 2015 (World Bank Data Help Desk, n.d.).

As presented in the table below, there are 38 developed economies and 21 developing economies present in the sample.

Then, in Table 4, are presented the descriptive statistics of all variables of our model in its original values apart from the liquidity measure that is already presented as the logarithm of the inverse of the Amihud's (2002) illiquidity measure and the market capitalization ratio. The descriptive statistics of the values after applying the logarithms are presented in Appendix 1.

Table 3 – Sample by economic development level

Developed Economies				***Developing Economies***	
Australia	Germany	New Zealand	Sweden	Argentina	Pakistan
Austria	Greece	Norway	Switzerland	Brazil	Peru
Bahrain	Hong Kong	Oman	United Arab Emirates	Bulgaria	Philippines
Belgium	Hungary	Poland	United Kingdom	China	Romania
Canada	Ireland	Portugal	United States	Colombia	Russia
Chile	Israel	Qatar		Egypt	South Africa
Cyprus	Italy	Republic of Korea		India	Sri Lanka
Czech Republic	Japan	Saudi Arabia		Indonesia	Thailand
Denmark	Kuwait	Singapore		Malaysia	Turkey
Finland	Luxembourg	Slovenia		Mexico	Venezuela
France	Netherlands	Spain		Morocco	

Table 4 – Descriptive statistics resume for all sample

Variable	***N (valid)***	***N (blank)***	***Average***	***Median***	***Standard Deviation***	***Minimum***	***Maximum***
HDI	1524	10	0,77534	0,79700	0,01206	0,40400	0,94900
LIQ	1342	192	9,92823	10,05107	1,80599	4,51643	13,44894
MC	1366	168	0,46105	0,29928	0,44325	0,00096	7,70775
GDP	1512	22	25372,13	21149,12	465793092,17	530,89	111968,35
MYS	1524	10	9,15	9,40	6,30	2,20	13,40
LE	1534	0	74,82	75,70	29,44	51,60	84,20

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) of the entire sample for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the real GDP per capita (*GDP*), the mean years of schooling (*MYS*) and the life expectancy at birth (*LE*).

Analysing the table above, one can see that only for the life expectancy variable it was possible to have the total amount of necessary observations. Only 10 observations were missing for the HDI and the mean years of schooling data, and this was because there was

no data available for the first ten years of these two measures for Oman. The market capitalization ratio and the liquidity data lack of 168 and 192 observations, respectively, which represents 11,0% and 12,5% of the total number of observations. For the real GDP per capita there were missing 22 observations specifically from Hungary (one observation), Kuwait (five observations), Qatar (ten observations), Slovenia (five observations) and Venezuela (one observation).

The HDI data has an average and median values very similar and a very small standard deviation. The less developed country of the whole sample, with an index of 0,404, is Pakistan in 1990 while the most developed country is Norway in 2015 with an index of 0,949.

The liquidity measure presents also very close values for the average and median values, but a very high standard deviation relatively to its average. The country with the less liquid stock market is the Czech Republic in 1993 with a liquidity value of 4,51643 while the most liquid is the United States stock market in 2015 with a liquidity value of 13,44894.

The market capitalization over GDP has very different average and median values. It also presents a big standard deviation relatively to its average value. The country with smaller market size relative to its own GDP is China in 1992 with a ratio of 0,00096 while the country with the biggest market size relatively to its own GDP is the Hong Kong in 2015 with a ratio of 7,70775.

Analysing the real GDP per capita, one can see that the average and median have different values and that the standard deviation is also very high, relatively to the average. The country with the lowest GDP per capita is India in 1991 with 530,89 US dollars whereas the country with higher GDP per capita is Luxembourg in 2007 with 111968,35 US dollars.

The mean years of schooling displays very similar average and median values and a high standard deviation, relatively to the average value. Its minimum, this is, the country with lowest schooling time average is Morocco in 1990 with 2,20 years while the maximum schooling time average is from Switzerland since 2010 until 2015 with 13,40 years (it presents the same average in all these years).

Finally, the life expectancy at birth, similarly to the mean years of schooling, shows an average and median values very alike and but a high standard deviation, comparatively to its average. The country that presented a shorter life expectancy was South Africa in 2005

with 51,60 years of living. The country where people expected to live longer was Hong Kong in 2015 with 84,20 years of living.

Next, to analyse the different subgroups formed to study the hypothesis H_2, the original sample is divided in two different subgroups: the group of developed countries and the group of developing countries. As mentioned before, this division is done taking into account 2015 economy development classification defined by the World Bank (World Bank Data Help Desk, n.d.). So, to comprehend better the results presented on the following chapter, Table 5 and Table 6 present the descriptive statistics of the both subgroups. The descriptive statistics of the values after applying the logarithms are presented in Appendix 1.

Table 5 – Descriptive statistics resume for the 38 developed countries

Variable	***N (valid)***	***N (blank)***	***Average***	***Median***	***Standard Deviation***	***Minimum***	***Maximum***
HDI	978	10	0,83949	0,84600	0,00301	0,66600	0,94900
LIQ	859	129	10,25379	10,25641	1,65079	4,51643	13,44894
MC	874	114	0,57901	0,38988	,61412	0,00294	7,70775
GDP	967	21	36668,24	35051,80	367319138,37	5510,63	111968,35
MYS	978	10	10,22	10,50	3,73	5,30	13,40
LE	988	0	77,74	78,00	9,32	67,20	84,20

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the real GDP per capita (*GDP*), the mean years of schooling (*MYS*) and the life expectancy at birth (*LE*) of the countries with developed economies.

Table 6 – Descriptive statistics resume for the 21 developing countries

Variable	***N (valid)***	***N (blank)***	***Average***	***Median***	***Standard Deviation***	***Minimum***	***Maximum***
HDI	546	0	0,66044	0,67050	0,00768	0,40400	0,82700
LIQ	483	63	9,34923	9,48667	1,56120	4,88822	12,55930
MC	492	54	0,25152	0,13778	0,07158	0,00096	1,42341
GDP	545	1	5329,29	4825,83	12237051,14	530,89	14652,24
MYS	546	0	7,23	7,20	5,17	2,20	12,00
LE	546	0	69,54	70,45	22,61	51,60	77,00

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (HDI), the logarithm of the inverse of the Amihud's (2002) measure (LIQ) and the control variables market capitalization

over GDP (MC), the real GDP per capita (GDP), the mean years of schooling (MYS) and the life expectancy at birth (LE) of the countries with developing economies.

Comparing the values of Table 5 and Table 6, is visible the superiority of the developed countries in terms of human development, as the HDI coefficient of this sub-sample presents higher average, median, minimum and maximum values. The difference between the medians of both groups is statistically significant in accordance with the Mann-Whitney test, which compares the median and data dispersion between of both subgroups (p-value=0,00). In terms of stock market liquidity, the developed countries present slightly higher stock market liquidity than the developing countries. This difference is evident and statistically significant in accordance with the Mann-Whitney (p-value=0,00). Relatively to the control variables, all presented much higher average and median values when analysing the developed countries. The differences between groups of all control variables are statistically significant, in conformity with the Mann-Whitney test (p-value=0,00). The extreme values are also bigger in the most developed countries for all measures.

Now on Table 7 and Table 8 are presented the descriptive statistics of the two sub-samples, when dividing it by time. The first table presents the analysis of the first period, previously to the 2008's crisis (1990-2007), whereas the second presents the analysis of the second period, after the crisis (2008-2015). The descriptive statistics of the values after applying the logarithms are presented in Appendix 1.

Table 7 – Descriptive statistics resume for all sampled countries – period 1990-2007

Variable	***N (valid)***	***N (blank)***	***Average***	***Median***	***Standard Deviation***	***Minimum***	***Maximum***
HDI	1052	10	0,75565	0,78200	0,01220	0,40400	0,93600
LIQ	870	192	9,77409	9,91084	1,84335	4,51643	13,31883
MC	895	167	0,35971	0,20635	0,24518	0,00096	6,06565
GDP	1041	21	23899,86	19591,40	429000539,78	530,89	111968,35
MYS	1052	10	8,69	8,90	6,23	2,20	13,10
LE	1062	0	73,86	75,00	27,29	51,60	82,60

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the real GDP per capita (*GDP*), the mean years of schooling (*MYS*) and the life expectancy at birth (*LE*), for all countries included in the sample, for the pre-crisis period (1990-2007).

Table 8 – Descriptive statistics resume for all sampled countries – period 2008-2015

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	472	0	0,81922	0,84200	0,00897	0,51400	0,94900
LIQ	472	0	10,21233	10,28359	1,61613	6,71954	13,44894
MC	471	1	0,65363	0,47684	0,76422	0,01212	7,70775
GDP	471	1	28626,11	22574,71	532785614,00	1037,58	108577,35
MYS	472	0	10,17	10,60	4,95	4,10	13,40
LE	472	0	76,98	78,20	27,60	52,80	84,20

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the real GDP per capita (*GDP*), the mean years of schooling (*MYS*) and the life expectancy at birth (*LE*) for all countries included in the sample, for the post-crisis period (2008-2015).

Analysing now the tables above, one can say that the human development level of all countries has increased in general, from the first to the second period in analysis, as the average, median, minimum and maximum values present higher values in the later data. According with the Mann-Whitney test, the difference of the median between periods is statistically significant (p-value=0,00). In terms of stock market liquidity, the values are similar in both time spans with a slightly increase in the later period. This difference, according to the Mann-Whitney test, the medians difference of both periods is statistically significant (p-value=0,00). Only the minimum value of the pre-crisis era is lower than the post-crisis era. Relatively to the remaining variables, all presented an increase of its average, median, minimum and maximum values for the later period, except for the GDP per capita that presents a bigger maximum in the pre-crisis era. The medians differences of all variables between periods is statically significant according to the Mann-Whitney test (GDP per capita: p-value=0,059; remaining control variables: p-value=0,00).

4. Results and discussion

Below are presented all the results obtained on this work and some commentaries about them substantiated based on the literature review.

The first sub-chapter is referent to the non-parametric correlation test, or the Spearman correlation coefficient. It is also presented two graphs showing the distribution of the HDI coefficients in relation to the stock market liquidity measure. Then, the following sub-chapter presents the various regressions results in accordance with all the proposed hypotheses.

4.1. Correlation analysis

The correlation coefficients calculated between the HDI coefficients and the stock market liquidity of each country are presented below. As it is used the logarithm of the inverse of Amihud's (2002) illiquidity measure, it is expected to get a positive correlation coefficient as one expects liquidity to be a lever to the country's development.

The results are divided in three tables: the first for the countries presenting a statistically significant positive correlation between the two variables (Table 9), the second for the countries with statistically significant negative correlations (Table 10) and the last one for the countries that did not present statistically significant results (Table 11).

In overall, 46 countries present the initially expected relationship between the HDI coefficients and its liquidity measurements. From the 13 remaining ones, 5 present a statistically significant negative relationship between the two analysed dimensions while the other 8 did not present statistically significant results.

From the statistically significant positively correlated countries, the majority presents a correlation coefficient bigger than 0,800, this is, an almost perfectly positive relationship. The country with the highest correlation coefficient is China (correlation coefficient of 0,989), followed by Turkey (correlation coefficient of 0,973) and Singapore (correlation coefficient of 0,968). The country that presents the lowest correlation coefficient is Netherlands (correlation coefficient of 0,347), then is Peru (correlation coefficient of 0,496), while the third lowest is Portugal (correlation coefficient of 0,585).

Table 9 – Spearman correlation values between HDI and liquidity for each country – positively correlated

Country	*Correlation Coefficient*	*Significance*	*N*	*Country*	*Correlation Coefficient*	*Significance*	*N*
Australia	,935***	,000	26	Mexico	,880***	,000	26
Austria	,711***	,000	26	Morocco	,758***	,000	22
Belgium	,716***	,000	26	Netherlands	,347*	,083	26
Brazil	,828***	,000	17	New Zealand	,832***	,000	26
Bulgaria	,618**	,011	16	Norway	,873***	,000	26
Canada	,916***	,000	26	Pakistan	,620***	,001	24
Chile	,874***	,000	26	Peru	,496**	,019	22
China	,989***	,000	25	Philippines	,783***	,000	26
Colombia	,833***	,000	24	Poland	,959***	,000	22
Czech Republic	,684***	,000	23	Portugal	,585***	,002	26
Denmark	,882***	,000	26	Qatar	,614**	,034	12
Egypt	,704***	,001	20	Republic of Korea	,960***	,000	26
Finland	,827***	,000	26	Romania	,904***	,000	20
France	,820***	,000	26	Russia	,711***	,001	18
Greece	,590***	,002	26	Singapore	,968***	,000	26
Hong Kong	,954***	,000	26	Spain	,816***	,000	26
Hungary	,628***	,001	25	Sweden	,860***	,000	26
India	,855***	,000	21	Switzerland	,854***	,000	26
Indonesia	,849***	,000	23	Thailand	,853***	,000	26
Israel	,895***	,000	23	Turkey	,973***	,000	26
Italy	,742***	,000	26	United Arab Emirates	,621**	,031	12
Japan	,867***	,000	26	United Kingdom	,624***	,001	26
Malaysia	,867***	,000	26	United States	,932***	,000	26

The table presents the Spearman correlation values between the HDI and stock market liquidity data for each country. The respective p-values and number of observations are presented at the right of each correlation coefficient.
*** the correlation is significant at the 0,01 level
** the correlation is significant at the 0,05 level
* the correlation is significant at the 0,10 level

Table 10 – Spearman correlation values between HDI and liquidity for each country – negatively correlated

Country	*Correlation Coefficient*	*Significance*	*N*
Argentina	-,613***	,002	23
Germany	-,805***	,000	26
Kuwait	-,765***	,004	12
Luxembourg	-,882***	,000	17
Venezuela	-,577***	,002	26

The table presents the Spearman correlation values between the HDI and stock market liquidity data for each country. The respective p-values and number of observations are presented at the right of each correlation coefficient.
*** the correlation is significant at the 0,01 level
** the correlation is significant at the 0,05 level
* the correlation is significant at the 0,10 level

Table 11 - Spearman correlation values between HDI and liquidity for each country – not statistically correlated

Country	*Correlation Coefficient*	*Significance*	*N*
Bahrain	,211	,511	12
Cyprus	,078	,725	23
Ireland	,181	,519	15
Oman	,269	,425	11
Saudi Arabia	-,199	,445	17
Slovenia	,082	,811	11
South Africa	,101	,623	26
Sri Lanka	,104	,615	26

The table presents the Spearman correlation values between the HDI and stock market liquidity data for each country. The respective p-values and number of observations are presented at the right of each correlation coefficient.

The countries with statistically significant negative correlations, those that presented a relationship contrary to the expected results, sorted by the coefficient value from the lowest to the highest, are Luxembourg, Germany, Kuwait, Argentina and Venezuela. Analysing

the extremities, Luxembourg presents a correlation coefficient of -0,882 while Venezuela has a correlation coefficient of -0,577.

The countries with no statistically significant correlation are Bahrain, Cyprus, Ireland, Oman, Saudi Arabia, Slovenia, South Africa and Sri Lanka. Some of these may have been influenced by the lack of stock market data as the observations' counts are low. However, the results of countries like Cyprus, Netherlands, South Africa or Sri Lanka, that present almost or the total number of available observations, can only be explained by data's informational content.

Concluding, the majority of the countries that compose our sample present a positive impact of the stock market liquidity on the countries' economic development, in accordance with various authors like Beck & Levine (2004), Cooray (2010), Enisan & Olufisayo (2009), Florackis et al. (2014), Levine & Zervos (1998), Meichle et al. (2011) or Næs et al. (2011) to name a few.

As a complement, below are presented the correlation coefficients of the four subgroups formed in this study to analyse if the relationship between the economic development and the stock market liquidity maintains when the data is multinational.

Table 12 – Spearman correlation values between HDI and liquidity by sample

Sample	***Correlation Coefficient***	***Significance***	***N***
Total	,490***	,000	1342
Developed	,524***	,000	859
Developing	,013	,774	483
1990-2007	,537***	,000	870
2008-2015	,372***	,000	472

The table presents the Spearman correlation values between the HDI and stock market liquidity data for each sample. The respective p-values and number of observations are presented at the right of each correlation coefficient.
*** the correlation is significant at the 0,01 level
** the correlation is significant at the 0,05 level
* the correlation is significant at the 0,10 level

Analysing the results above, all the samples present the expected correlation coefficient sign with statistically significant meaning, apart from the subgroup of developing countries, which presents a not statistically significant relationship between the economic development and the stock market liquidity. This result suggests that the stock market

liquidity of the developing countries, in general, does not have any influence on the countries' economic development, possibly due to the lower development of these stock markets and meets the results obtained by Adjasi & Biekpe (2006). In their work, two different illiquidity measures were tested, presenting both not significant results for the less developed economies. These authors state that these results may be related to the stock market development level, as being lower, its impact is not well perceived in the countries' economic development.

Figure 2 and Figure 3 present two graphs plotting the relationship between countries' development level and its stock market liquidity. These aim to give visual information about the correlation results previously presented. The first is relative to the economically developed countries while the second is for the economically developing countries.

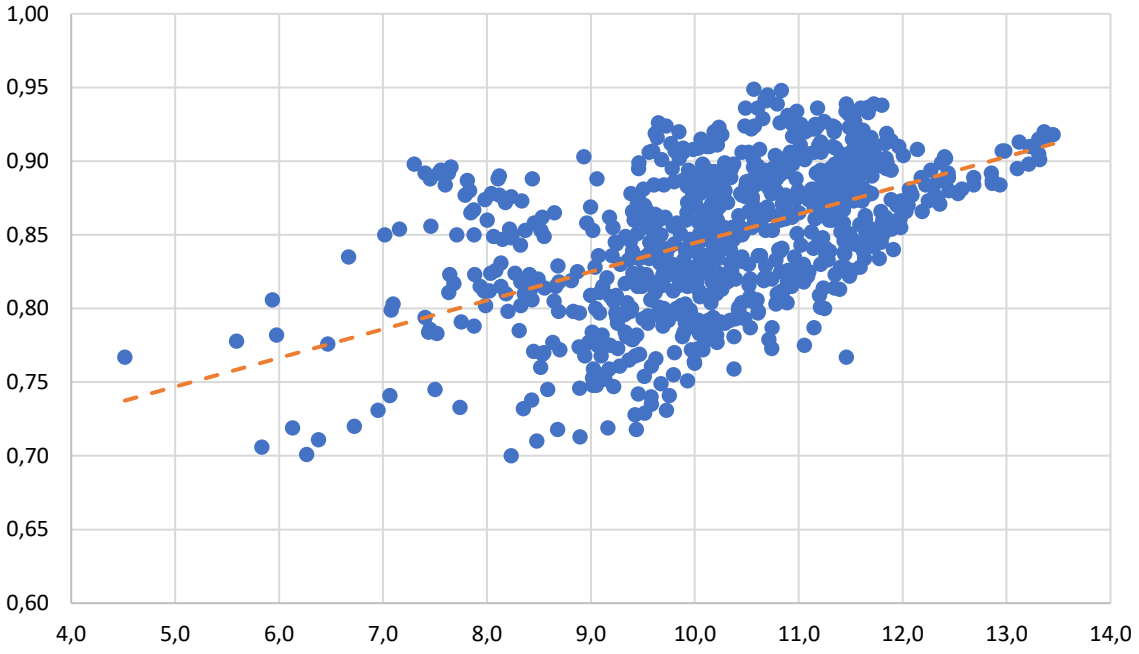

Figure 2 – HDI coefficients against liquidity logarithm – developed countries

Analysing the graphs, one can say that only the developed countries present a more solid tendency to react positively to an increase of the stock market liquidity. The tendency line of the developing countries is flat, thus not presenting any relationship between the two dimensions. Examining data dispersion, the first graph presents more concentrated data than the second and an easily seen increasing tendency, which are in line with the tendency lines slope.

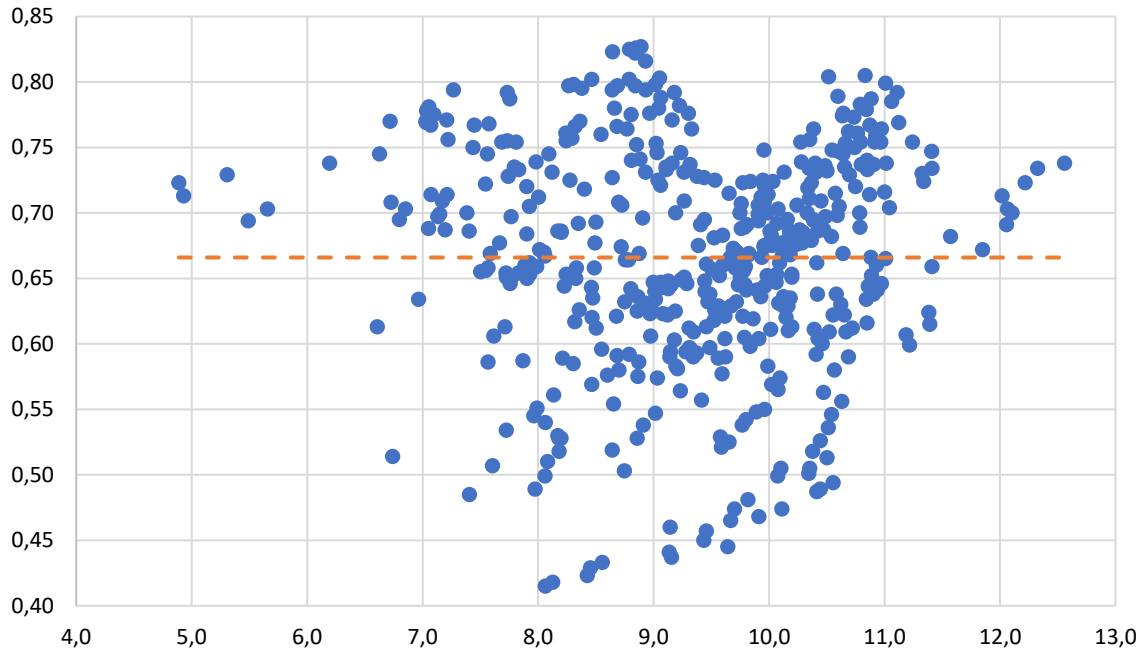

Figure 3 – HDI coefficients against liquidity logarithm – developing countries

Finally, to visualize the data of both subperiods, Figure 4 and Figure 5 present the HDI coefficients of all countries plotted against the stock market liquidity for the periods 1990-2007 and 2008-2015, respectively.

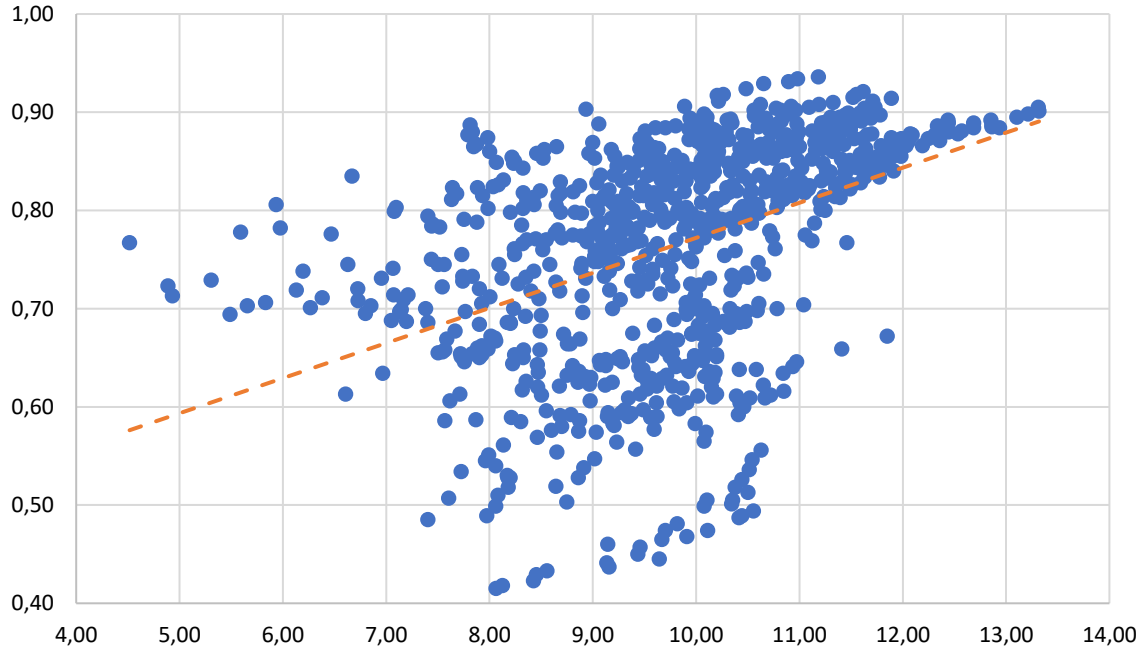

Figure 4 - HDI coefficients against liquidity logarithm – pre-crisis era

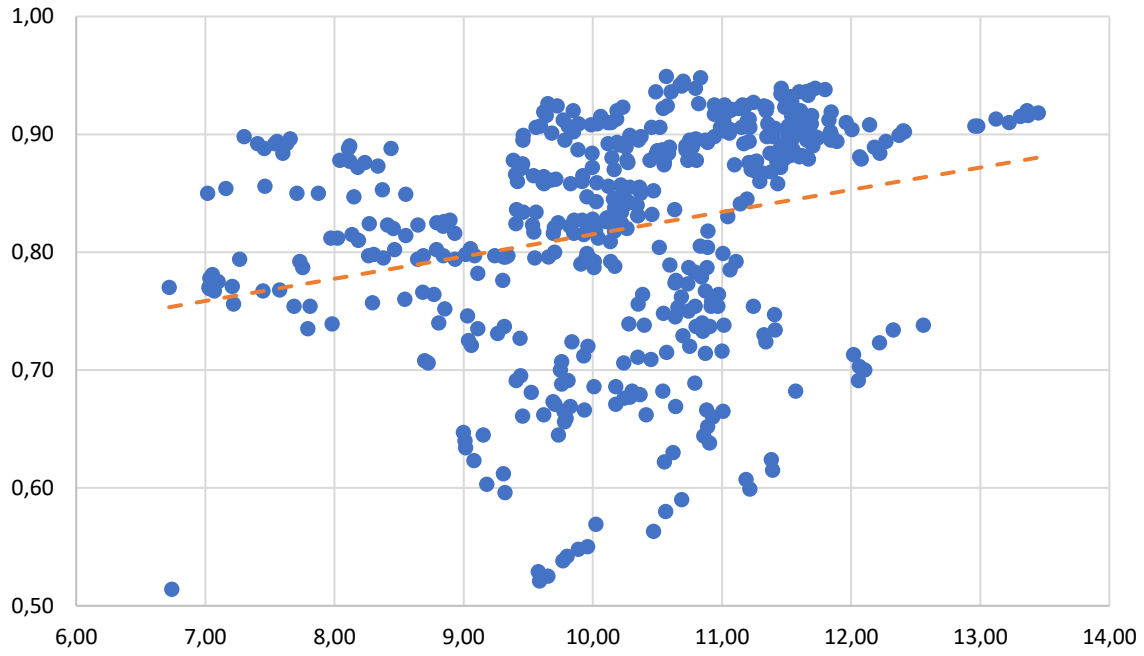

Figure 5 - HDI coefficients against liquidity logarithm – post-crisis era

Examining both graphs above, one can see that the period before the economic crisis of 2008 presents a more pronounced relationship between the stock market liquidity and the economic development as the tendency line shows a steeper slope than the period after the crisis. The data dispersion also seems to be different between periods, with the pre-crisis era presenting a more pronounced increasing pattern of the HDI relatively to the stock market liquidity.

4.2. Regression analysis

Here are presented the results relative to the empirical model regression. Firstly, are exhibited the results for the entire sample, this is, using the data from the 59 countries with the time span ranging from 1990 to 2015. Thereon, are presented the regression results of the developed countries and the developing countries using the entire time range. The last results presented are relative to the analysis of the 2008 economic crisis impact, dividing the global sample in two different time ranges: from 1990 to 2007 and from 2008 to 2015. In the end, is made a comparison between all results to get a global analysis to comprehend better the impact of the stock market liquidity on countries' development.

4.2.1. Global overview

As explained before, for all regressions were tested the pooled OLS model and the fixed and random effects regression models. Based on the results obtained by the F, Breusch-Pagan and Hausman tests, the most suitable model is selected and presented in this chapter, while the remaining results are presented in the respective appendix.

Therefore, analysing the F, Breusch-Pagan and Hausman tests' results presented on Appendix 2, the most adequate regression model is the fixed effects regression model, which is presented below. Consequently, the regression results for the complete sample analysis are presented below on Table 13. The results outputs of the pooled OLS and random effects models are presented in Appendix 2, as well as the result output of the fixed effects model.

Table 13 – Fixed effects regression results – entire sample

Variable	***Coefficient***	***Standard Error***	***P-value***	***Sig.***
LIQ_{t-1}	0,00144	0,00035	<0,0001	***
MC_{t-1}	0,00103	0,00061	0,0913	*
GDP_{t-1}	0,14310	0,00434	<0,0001	***
MYS_{t-1}	0,28940	0,00599	<0,0001	***
LE_{t-1}	1,11097	0,02962	<0,0001	***

The table displays the fixed effects regression results using the entire sample. The model is composed as presented earlier, with the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean schooling years logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*).The first column presents the regression coefficient, followed by its standard error, p-value and relative significance note.
*** denotes statistical significance at the 0,01 level
** denotes statistical significance at the 0,05 level
* denotes statistical significance at the 0,10 level

All coefficients present statistically significant values, yet, the market capitalization is only significant at the 10% level while the remaining coefficients are statistically significant at the 1% level with very low p-values. Liquidity features a positive statistically significant impact on the economic development, which is according to the results obtained by Apergis et al. (2015), Florackis et al. (2014), Meichle et al. (2011), Næs et al. (2011) and Smimou (2014) that also used the Amihud's (2002) illiquidity measure (note that the illiquidity values used in the regression are inverted and relativized, representing now the stock market's liquidity status). The remaining variables present also a positive coefficient, thus, affecting

positively the economic development. Lastly, the constant presents a statistically significant negative value.

Concluding, as the results above present a statistically significant positive impact of the stock market liquidity on the countries' economic development, the first hypotheses H_1 is verified.

4.2.2. Economic development analysis

In this subchapter is analysed the impact difference of the stock market liquidity on the countries' economic development dividing the initial sample by the economic development level of the countries.

When analysing the F, Breusch-Pagan and Hausman tests results presented on Appendix 3, one can see that the most suitable regressor is the fixed effects model. Thus, on Table 14 are presented the regression results. The result outputs of the pooled OLS and random effects models are presented in Appendix 3, as well as the result output of the fixed effects model.

Table 14 – Fixed effects regression results – economic development analysis

	Variable	***Coefficient***	***Standard Error***	***P-value***	***Sig.***
Developing Countries	LIQ_{t-1}	-0,00149	0,00057	0,0089	***
	MC_{t-1}	-0,00252	0,00240	0,2939	
	GDP_{t-1}	0,17381	0,00543	<0,0001	***
	MYS_{t-1}	0,27777	0,00708	<0,0001	***
	LE_{t-1}	0,96264	0,03335	<0,0001	***
Developed Countries Difference	LIQ_{t-1}	0,00423	0,00071	<0,0001	***
	MC_{t-1}	0,00287	0,00248	0,2479	
	GDP_{t-1}	-0,07185	0,00960	<0,0001	***
	MYS_{t-1}	0,02652	0,01276	0,0379	**
	LE_{t-1}	0,41634	0,07057	<0,0001	***

The table displays the fixed effects regression results using the initial sample divided by development level of the studied countries defined by the World Bank in 2015. The developed countries group contains 38 countries while the developing countries group is composed by 21 countries. The model is composed as presented earlier in equation (3.2) with the dummy variable defined as 1 for developed countries, with the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean

schooling years logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*).The second column presents the regression coefficient, followed by its standard error, p-value and relative significance note.
*** denotes statistical significance at the 0,01 level
** denotes statistical significance at the 0,05 level
* denotes statistical significance at the 0,10 level

Analysing the regression results for the developing countries, one can see that all the coefficients are statistically significant at the 1% level, apart from the market size coefficient. Analysing the signs, the stock market liquidity of the developing economies presents a statistically significant negative effect on the countries' economic development. Although this result is against the initial expectations, is in line with the N'Zué (2006) and Nurudeen (2009) conclusions when testing for the same relationship for two other developing countries. The results of their studies were coherent, presenting statistically significant negative results when testing for correlation or presenting no causality running from the stock market liquidity to the economic development measure. Nurudeen (2009) justifies these results by the difficulties involved in trading shares like the high transaction costs or due to the delays in the issuance of shares certificates. These issues can lead to production and liquidity shocks, as well as to the contraction of output and economic downturn. The GPD per capita, mean years of schooling and life expectancy logarithms present statistically significant positive coefficients as predicted.

In terms of the impact changes of the developed countries, similarly to the results of developing countries, all the coefficients present statistically significant values, excluding the market size term. Relatively to the stock market liquidity change, it presents a positive sign, suggesting that the developed economies enjoy more the benefits of the stock market than the developing economies. This result is different from the Adjasi & Biekpe (2006) and Hou & Cheng (2017) works, as they apply different methodologies, not studying the coefficients' changes between development classifications but studying the different subgroups individually. The first presents a statistically significant relationship between the stock market liquidity and the economic development for the most developed countries, whereas the second presents not significant results for the countries with higher income. The impact change of the GDP per capita logarithm presents a negative value, suggesting this variable has less influence on developed countries development, while the two social measures present a statistically significant positive impact change in comparison to the developing economies.

Resuming, the results above show a statistically significantly change of the stock market liquidity when the sample is divided by the countries' economic development level, corroborating our second hypotheses H_2.

4.2.3. 2008's crisis impact

Lastly, in this subchapter are presented the results of the 2008 economic crisis impact on the relationship between the stock market liquidity and the economic development, dividing the initial sample in two periods.

Examining the results of the F, Breusch-Pagan and Hausman tests presented in Appendix 4, the fixed effects model is once more the most suitable regressor. Its results are presented in Table 15. As explained before, the first sub-sample comprises the data from 1990 to 2007, prior to the economic crisis of 2008. The second sub-sample includes the data from 2008 to 2015. The results outputs of the pooled OLS and random effects models are presented in Appendix 4, as well as the result output of the fixed effects model.

Table 15 – Fixed effects regression results – 2008 crisis analysis

	Variable	***Coefficient***	***Standard Error***	***P-value***	***Sig.***
Pre-crisis Era	LIQ_{t-1}	0,00163	0,00037	<0,0001	***
	MC_{t-1}	0,00185	0,00092	0,0439	**
	GDP_{t-1}	0,14638	0,00481	<0,0001	***
	MYS_{t-1}	0,28492	0,00623	<0,0001	***
	LE_{t-1}	1,04786	0,03173	<0,0001	***
Post-crisis Era Differences	LIQ_{t-1}	-0,00098	0,00037	0,0075	***
	MC_{t-1}	-0,00112	0,00074	0,1292	
	GDP_{t-1}	0,00429	0,00140	0,0023	***
	MYS_{t-1}	-0,00562	0,00588	0,3390	
	LE_{t-1}	0,00673	0,00327	0,0397	**

The table displays the fixed effects regression results using the initial sample divided by time. The first is relative to the time span 1990-2007 whereas the other is relative to 2008-2015. All the 59 countries were studied in this analysis. The model is composed as presented earlier in equation (3.2) with the dummy variable defined as 1 for the post-crisis period, with the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean schooling years logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*).The first column presents the regression coefficient, followed by its standard error, p-value and relative significance note.

*** denotes statistical significance at the 0,01 level
** denotes statistical significance at the 0,05 level
* denotes statistical significance at the 0,10 level

Analysing first the pre-crisis period coefficients, all the terms present statistically significant values at the 1% level apart from the market size term that has a significance of 5%. The stock market liquidity presents a statistically significant positive coefficient as expected. Although these results analyse the pre-crisis period, its meaning can be compared with the remaining studies, as it can be considered a simple sample. Therefore, the obtained coefficient is in accordance with the studies of Apergis et al. (2015), Florackis et al. (2014), Meichle et al. (2011), Næs et al. (2011) and Smimou (2014) that have also applied the Amihud's (2002) illiquidity measure. All remaining control variables present also positive values, in accordance with the initial beliefs.

Analysing now the changes of the post-crisis period in relation to the pre-crisis period, it is noticeable that the capital market size and the educational indicator present non-significant coefficients. Only the stock market liquidity and the GDP per capita and life expectancy logarithms present statistically significant changes in relation to the previous period. The first, present a negative difference, suggesting that the impact of the stock market liquidity on the countries' economic development after the 2008 crisis is less than in the previous period. This statistically significant negative change could be justified by the fact that investor's caution increased, after many of them having suffered big losses during this crisis. Lastly, the other two control variables present positive differences.

Concluding, the results show that the stock market liquidity after the 2008's crisis is statistically significantly different from the previous period, corroborating the third and last hypothesis H_3.

5. Conclusion

The main aim of this work is to analyse the relationship between the stock market liquidity and the economic development using the Human Development Index (HDI) as proxy for the economic development. To our knowledge, this is the first study including this index as a variable to measure a country's economic development, which is the main contribute and innovation of the current work. Another key feature of this work is the sample representativeness, as this study presents the most complete sample among the reviewed works.

The stock market liquidity was calculated through the logarithm of the inverse of the Amihud's (2002) illiquidity measure, presenting statistically significant results in all regression analysis in accordance with Apergis et al. (2015), Florackis et al. (2014), Meichle et al. (2011), Næs et al. (2011) and Smimou (2014) studies. This study presents also statistically significant changes of the stock market liquidity impact when dividing the sample by the economic development level and by period previous and after the 2008 economic crisis. Only the developing countries presented a statistically significant negative relationship between the stock market liquidity and the economic development. Although this result is against the initial expectations, is in line with the N'Zué (2006) and Nurudeen (2009) conclusions. Nurudeen (2009) justifies these results by the difficulties involved in trading shares like the high transaction costs or due to the delays in the issuance of shares certificate. These issues can lead to production and liquidity shocks, as well as to the contraction of output and to the economic downturn.

These results suggest that policy makers and regulatory entities, specially from the developing economies, should create more proactive politics and development programs to increase the stock market development by means of increasing its liquidity. Similarly, to not lose the benefits from having a stock market, all countries should create investment incentive programs, so the investors can retrieve its confidence after the 2008 crisis, recovering from the apparent stock market liquidity losses more quickly and restoring its influence on the countries' economic development.

As future work, one can extend the sample in terms of time range as the HDI data will be extended over the years, making possible to increase the sample robustness when dividing it by time. Another way to enhance this study results would be to use other social variables

that could replace the two variables used in this work as both presented very high regression coefficients due to its proximity to the HDI calculation method. This issue perchance clouded the effect of the remaining variables on the economic development. The adding of extra variables could also be another improvement to this work.

Moreover, the accuracy and reliability of this study could be enhanced by calculating the liquidity of the stock markets using the data from all shares present on that stock market instead of using the Datastream indices data. As there will be more observations, the calculated liquidity will be more realistic.

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Appendices

Appendix 1

Table 16 – Descriptive statistics resume for all sample (resized data)

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	1524	10	0,77534	0,79700	0,01206	0,40400	0,94900
LIQ	1342	192	9,92823	10,05107	1,80599	4,51643	13,44894
MC	1366	168	0,46105	0,29928	0,44325	0,00096	7,70775
GDP	1512	22	1,18005	1,32529	0,26632	-0,27499	2,04910
MYS	1524	10	0,94094	0,97313	0,02014	0,34242	1,12710
LE	1534	0	1,87281	1,87910	0,00109	1,71265	1,92531

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) of the entire sample for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean years of schooling logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*).

Table 17 – Descriptive statistics resume for the 38 developed countries (resized data)

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	978	10	0,83949	0,84600	0,00301	0,66600	0,94900
LIQ	859	129	10,25379	10,25641	1,65079	4,51643	13,44894
MC	874	114	0,57901	0,38988	,61412	0,00294	7,70775
GDP	967	21	1,50252	1,54471	0,05875	,74120	2,04910
MYS	978	10	1,00060	1,02119	0,00812	0,72428	1,12710
LE	988	0	1,89029	1,89209	0,00030	1,82737	1,92531

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean years of schooling logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*) of the countries with developed economies.

Table 18 – Descriptive statistics resume for the 21 developing countries (resized data)

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	546	0	0,66044	0,67050	0,00768	0,40400	0,82700
LIQ	483	63	9,34923	9,48667	1,56120	4,88822	12,55930
MC	492	54	0,25152	0,13778	0,07158	0,00096	1,42341
GDP	545	1	0,60790	0,68357	0,12260	-0,27499	1,16590
MYS	546	0	0,83409	0,85733	0,02389	0,34242	1,07918
LE	546	0	1,84118	1,84788	0,00098	1,71265	1,88649

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (HDI), the logarithm of the inverse of the Amihud's (2002) measure (LIQ) and the control variables market capitalization over GDP (MC), the logarithm of real GDP per capita (GDP), the mean years of schooling logarithm (MYS) and the life expectancy at birth logarithm (LE) of the countries with developing economies.

Table 19 – Descriptive statistics resume for all sampled countries – period 1990-2007 (resized data)

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	1052	10	0,75565	0,78200	0,01220	0,40400	0,93600
LIQ	870	192	9,77409	9,91084	1,84335	4,51643	13,31883
MC	895	167	0,35971	0,20635	0,24518	0,00096	6,06565
GDP	1041	21	1,14228	1,29207	0,28174	-0,27499	2,04910
MYS	1052	10	0,91675	0,94939	0,02199	0,34242	1,11727
LE	1062	0	1,86727	1,87506	0,00104	1,71265	1,91698

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean years of schooling logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*), for all countries included in the sample, for the pre-crisis period (1990-2007).

Table 20 – Descriptive statistics resume for all sampled countries – period 2008-2015 (resized data)

Variable	*N (valid)*	*N (blank)*	*Average*	*Median*	*Standard Deviation*	*Minimum*	*Maximum*
HDI	472	0	0,81922	0,84200	0,00897	0,51400	0,94900
LIQ	472	0	10,21233	10,28359	1,61613	6,71954	13,44894
MC	471	1	0,65363	0,47684	0,76422	0,01212	7,70775
GDP	471	1	1,26355	1,35362	0,22261	0,01602	2,03574
MYS	472	0	,99486	1,02531	,01184	,61278	1,12710
LE	472	0	1,88528	1,89321	,00099	1,72263	1,92531

The table shows the descriptive statistics (number of valid and blank observations, average, median, standard deviation, minimum and maximum) for the dependent variable Human Development Index (*HDI*), the logarithm of the inverse of the Amihud's (2002) measure (*LIQ*) and the control variables market capitalization over GDP (*MC*), the logarithm of real GDP per capita (*GDP*), the mean years of schooling logarithm (*MYS*) and the life expectancy at birth logarithm (*LE*) for all countries included in the sample, for the post-crisis period (2008-2015).

Appendix 2

Modelo 3: Mínimos Quadrados de amostragem ("Pooled OLS"), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	−1,43373	0,0351849	−40,75	<0,0001	***
LIQ_1	0,00318277	0,000342093	9,304	<0,0001	***
MC_1	0,000886839	0,000673644	1,316	0,1883	
GDP_1	0,0815360	0,00140597	57,99	<0,0001	***
MYS_1	0,331857	0,00422397	78,57	<0,0001	***
LE_1	0,946879	0,0195265	48,49	<0,0001	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,249897	E.P. da regressão	0,014038
R-quadrado	0,983000	R-quadrado ajustado	0,982933
F(5, 1268)	14664,43	valor P(F)	0,000000
Log. da verosimilhança	3630,102	Critério de Akaike	−7248,204
Critério de Schwarz	−7217,305	Critério Hannan-Quinn	−7236,599
rho	0,937752	Durbin-Watson	0,095924

Figure 6 – Pooled OLS regression results – entire sample

Modelo 1: Efeitos-fixos, usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	-1,75709	0,0509990	-34,45	<0,0001	***
LIQ_1	0,00143896	0,000352750	4,079	<0,0001	***
MC_1	0,00103493	0,000612497	1,690	0,0913	*
GDP_1	0,143102	0,00433859	32,98	<0,0001	***
MYS_1	0,289399	0,00598691	48,34	<0,0001	***
LE_1	1,11097	0,0296239	37,50	<0,0001	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,056511	E.P. da regressão	0,006834
LSDV R-quadrado	0,996156	Dentro R-quadrado	0,964889
LSDV F(63, 1210)	4976,899	valor P(F)	0,000000
Log. da verosimilhança	4577,070	Critério de Akaike	-9026,140
Critério de Schwarz	-8696,545	Critério Hannan-Quinn	-8902,351
rho	0,721699	Durbin-Watson	0,421883

Teste conjunto em regressores designados -
Estatística de teste: F(5, 1210) = 6650,37
com valor p = P(F(5, 1210) > 6650,37) = 0

Teste para diferenciar grupos de intercepções no eixo x=0 -
Hipótese nula: Os grupos têm a mesma intercepção no eixo x=0
Estatística de teste: F(58, 1210) = 71,3913
com valor p = P(F(58, 1210) > 71,3913) = 0

Figure 7 – Fixed effects regression results – entire sample

Modelo 2: Efeitos-aleatórios (GLS), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*z*	*valor p*	
const	-1,82409	0,0509914	-35,77	<0,0001	***
LIQ_1	0,00286077	0,000350756	8,156	<0,0001	***
MC_1	0,00215807	0,000637196	3,387	0,0007	***
GDP_1	0,104377	0,00326904	31,93	<0,0001	***
MYS_1	0,304187	0,00600820	50,63	<0,0001	***
LE_1	1,15652	0,0294615	39,26	<0,0001	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,549063	E.P. da regressão	0,020801
Log. da verosimilhança	3128,678	Critério de Akaike	-6245,355
Critério de Schwarz	-6214,456	Critério Hannan-Quinn	-6233,750

'Por entre' a variância = 0,000158702
'Por dentro' da variância = 4,67036e-005
teta média = 0,880843

Teste conjunto em regressores designados -
Estatística de teste assimptótica: Qui-quadrado(5) = 32109,1
com valor p = 0

Teste de Breusch-Pagan -
Hipótese nula: Variância do erro de unidade-específica = 0
Estatística de teste assimptótica: Qui-quadrado(1) = 5046,07
com valor p = 0

Teste de Hausman -
Hipótese nula: As estimativas GLS são consistentes
Estatística de teste assimptótica: Qui-quadrado(5) = 186,564
com valor p = 2,11876e-038

Figure 8 – Random effects regression results – entire sample

Appendix 3

Modelo 1: Mínimos Quadrados de amostragem ("Pooled OLS"), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	−1,35750	0,0419517	−32,36	<0,0001	***
LIQ_1	0,000988963	0,000652137	1,516	0,1296	
MC_1	0,00687025	0,00307981	2,231	0,0259	**
GDP_1	0,0849162	0,00230719	36,80	<0,0001	***
MYS_1	0,328370	0,00553172	59,36	<0,0001	***
LE_1	0,915852	0,0228998	39,99	<0,0001	***
LIQDeveloped_1	0,00352840	0,000788321	4,476	<0,0001	***
MCDeveloped_1	−0,00651554	0,00316066	−2,061	0,0395	**
GDPDeveloped_1	−0,0146460	0,00339528	−4,314	<0,0001	***
MYSDeveloped_1	−0,0110671	0,00892929	−1,239	0,2154	
LEDeveloped_1	0,0648461	0,0516092	1,256	0,2092	
DevelopmentLevel_1	−0,121424	0,0933476	−1,301	0,1936	

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,240100	E.P. da regressão	0,013793
R-quadrado	0,983667	R-quadrado ajustado	0,983525
F(11, 1262)	6909,487	valor P(F)	0,000000
Log. da verosimilhança	3655,578	Critério de Akaike	−7287,156
Critério de Schwarz	−7225,357	Critério Hannan-Quinn	−7263,946
rho	0,934937	Durbin-Watson	0,098808

Figure 9 – Pooled OLS regression results – economic development analysis

Modelo 2: Efeitos-fixos, usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	-1,95635	0,0695625	-28,12	<0,0001	***
LIQ_1	-0,00149455	0,000570188	-2,621	0,0089	***
MC_1	-0,00251678	0,00239680	-1,050	0,2939	
GDP_1	0,173806	0,00543372	31,99	<0,0001	***
MYS_1	0,277769	0,00708482	39,21	<0,0001	***
LE_1	0,962642	0,0333489	28,87	<0,0001	***
LIQDeveloped_1	0,00422802	0,000713477	5,926	<0,0001	***
MCDeveloped_1	0,00286829	0,00248129	1,156	0,2479	
GDPDeveloped_1	-0,0718455	0,00960441	-7,480	<0,0001	***
MYSDeveloped_1	0,0265237	0,0127622	2,078	0,0379	**
LEDeveloped_1	0,416335	0,0705685	5,900	<0,0001	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,050720	E.P. da regressão	0,006488
LSDV R-quadrado	0,996550	Dentro R-quadrado	0,968487
LSDV F(68, 1205)	5118,239	valor P(F)	0,000000
Log. da verosimilhança	4645,944	Critério de Akaike	-9153,887
Critério de Schwarz	-8798,543	Critério Hannan-Quinn	-9020,427
rho	0,715418	Durbin-Watson	0,453339

Teste conjunto em regressores designados -
Estatística de teste: F(10, 1205) = 3703,32
com valor p = P(F(10, 1205) > 3703,32) = 0

Teste para diferenciar grupos de intercepções no eixo x=0 -
Hipótese nula: Os grupos têm a mesma intercepção no eixo x=0
Estatística de teste: F(57, 1205) = 78,9344
com valor p = P(F(57, 1205) > 78,9344) = 0

Figure 10 - Fixed effects regression results – economic development analysis

Modelo 3: Efeitos-aleatórios (GLS), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*z*	*valor p*	
const	-1,48776	0,0573150	-25,96	<0,0001	***
LIQ_1	-0,000344466	0,000569390	-0,6050	0,5452	
MC_1	0,00161761	0,00243276	0,6649	0,5061	
GDP_1	0,148965	0,00486272	30,63	<0,0001	***
MYS_1	0,284219	0,00705538	40,28	<0,0001	***
LE_1	0,993168	0,0326004	30,46	<0,0001	***
LIQDeveloped_1	0,00346173	0,000715399	4,839	<0,0001	***
MCDeveloped_1	-0,000887380	0,00251778	-0,3524	0,7245	
GDPDeveloped_1	-0,0644785	0,00799821	-8,062	<0,0001	***
MYSDeveloped_1	0,0217693	0,0125523	1,734	0,0829	*
LEDeveloped_1	0,436490	0,0660738	6,606	<0,0001	***
DevelopmentLevel_1	-0,835633	0,112129	-7,452	<0,0001	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,488334	E.P. da regressão	0,019663
Log. da verosimilhanÃ§a	3203,342	Critério de Akaike	-6382,685
Critério de Schwarz	-6320,886	Critério Hannan-Quinn	-6359,474

'Por entre' a variância = 0,000141856
'Por dentro' da variância = 4,20913e-005
teta média = 0,880359

Teste conjunto em regressores designados -
Estatística de teste assimptótica: Qui-quadrado(11) = 37439,4
com valor p = 0

Teste de Breusch-Pagan -
Hipótese nula: Variância do erro de unidade-específica = 0
Estatística de teste assimptótica: Qui-quadrado(1) = 4790,08
com valor p = 0

Teste de Hausman -
Hipótese nula: As estimativas GLS são consistentes
Estatística de teste assimptótica: Qui-quadrado(10) = 130,269
com valor p = 4,11698e-023

Figure 11 - Random effects regression results – economic development analysis

Appendix 4

Modelo 1: Mínimos Quadrados de amostragem ("Pooled OLS"), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	−1,31028	0,0427219	−30,67	<0,0001	***
LIQ_1	0,00338075	0,000409114	8,264	<0,0001	***
MC_1	0,000729228	0,00103990	0,7013	0,4833	
GDP_1	0,0869549	0,00164495	52,86	<0,0001	***
MYS_1	0,322991	0,00468113	69,00	<0,0001	***
LE_1	0,879662	0,0236743	37,16	<0,0001	***
LIQ0815_1	−0,00149148	0,000701555	−2,126	0,0337	**
MC0815_1	−0,00077959 8	0,00133733	−0,5829	0,5600	
GDP0815_1	−0,00975926	0,00302340	−3,228	0,0013	***
MYS0815_1	0,00753321	0,00988219	0,7623	0,4460	
LE0815_1	0,106260	0,0396085	2,683	0,0074	***
AfterCrisis_1	−0,171398	0,0720540	−2,379	0,0175	**

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,228625	E.P. da regressão	0,013460
R-quadrado	0,984447	R-quadrado ajustado	0,984312
F(11, 1262)	7262,037	valor P(F)	0,000000
Log. da verosimilhança	3686,773	Critério de Akaike	−7349,546
Critério de Schwarz	−7287,747	Critério Hannan-Quinn	−7326,336
rho	0,923637	Durbin-Watson	0,121905

Figure 12 – Pooled OLS regression results – 2008 crisis analysis

Modelo 2: Efeitos-fixos, usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*rácio-t*	*valor p*	
const	-1,60920	0,0579374	-27,77	<0,0001	***
LIQ_1	0,00167099	0,000368403	4,536	<0,0001	***
MC_1	0,00190214	0,000916379	2,076	0,0381	**
GDP_1	0,145950	0,00481034	30,34	<0,0001	***
MYS_1	0,287002	0,00632449	45,38	<0,0001	***
LE_1	1,02976	0,0331149	31,10	<0,0001	***
LIQ0815_1	-0,000907203	0,000368961	-2,459	0,0141	**
MC0815_1	-0,00124846	0,000740098	-1,687	0,0919	*
GDP0815_1	0,00207891	0,00182455	1,139	0,2548	
MYS0815_1	-0,00403995	0,00592854	-0,6814	0,4957	
LE0815_1	0,0449500	0,0205209	2,190	0,0287	**
AfterCrisis_1	-0,0714342	0,0378622	-1,887	0,0594	*

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,054882	E.P. da regressão	0,006752
LSDV R-quadrado	0,996267	Dentro R-quadrado	0,965901
LSDV F(69, 1204)	4656,357	valor P(F)	0,000000
Log. da verosimilhança	4595,707	Critério de Akaike	-9051,415
Critério de Schwarz	-8690,920	Critério Hannan-Quinn	-8916,020
rho	0,709188	Durbin-Watson	0,447360

Teste conjunto em regressores designados -
Estatística de teste: F(11, 1204) = 3100,46
com valor p = P(F(11, 1204) > 3100,46) = 0

Teste para diferenciar grupos de intercepções no eixo x=0 -
Hipótese nula: Os grupos têm a mesma intercepção no eixo x=0
Estatística de teste: F(58, 1204) = 65,7168
com valor p = P(F(58, 1204) > 65,7168) = 0

Figure 13 - Fixed effects regression results – 2008 crisis analysis

Modelo 3: Efeitos-aleatórios (GLS), usando 1274 observações
Incluídas 59 unidades de secção-cruzada
Comprimento da série temporal: mínimo 9, máximo 25
Variável dependente: HDI

	Coeficiente	*Erro Padrão*	*z*	*valor p*	
const	-1,61634	0,0572804	-28,22	<0,0001	***
LIQ_1	0,00318250	0,000360885	8,819	<0,0001	***
MC_1	0,00350983	0,000944290	3,717	0,0002	***
GDP_1	0,100057	0,00308731	32,41	<0,0001	***
MYS_1	0,297565	0,00619817	48,01	<0,0001	***
LE_1	1,04903	0,0325376	32,24	<0,0001	***
LIQ0815_1	-0,000655932	0,000392200	-1,672	0,0944	*
MC0815_1	-0,00177692	0,000783827	-2,267	0,0234	**
GDP0815_1	-0,00585755	0,00180837	-3,239	0,0012	***
MYS0815_1	0,0110653	0,00608600	1,818	0,0690	*
LE0815_1	0,0703981	0,0217594	3,235	0,0012	***
AfterCrisis_1	-0,124296	0,0400316	-3,105	0,0019	***

Média var. dependente	0,787210	D.P. var. dependente	0,107460
Soma resíd. quadrados	0,364095	E.P. da regressão	0,016979
Log. da verosimilhança	3390,356	Critério de Akaike	-6756,713
Critério de Schwarz	-6694,914	Critério Hannan-Quinn	-6733,502

'Por entre' a variância = 0,000117157
'Por dentro' da variância = 4,5583e-005
teta média = 0,863327

Teste conjunto em regressores designados -
Estatística de teste assimptótica: Qui-quadrado(11) = 34068,6
com valor p = 0

Teste de Breusch-Pagan -
Hipótese nula: Variância do erro de unidade-específica = 0
Estatística de teste assimptótica: Qui-quadrado(1) = 5434,81
com valor p = 0

Teste de Hausman -
Hipótese nula: As estimativas GLS são consistentes
Estatística de teste assimptótica: Qui-quadrado(11) = 189,435
com valor p = 1,14976e-034

Figure 14 - Random effects regression results – 2008 crisis analysis

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